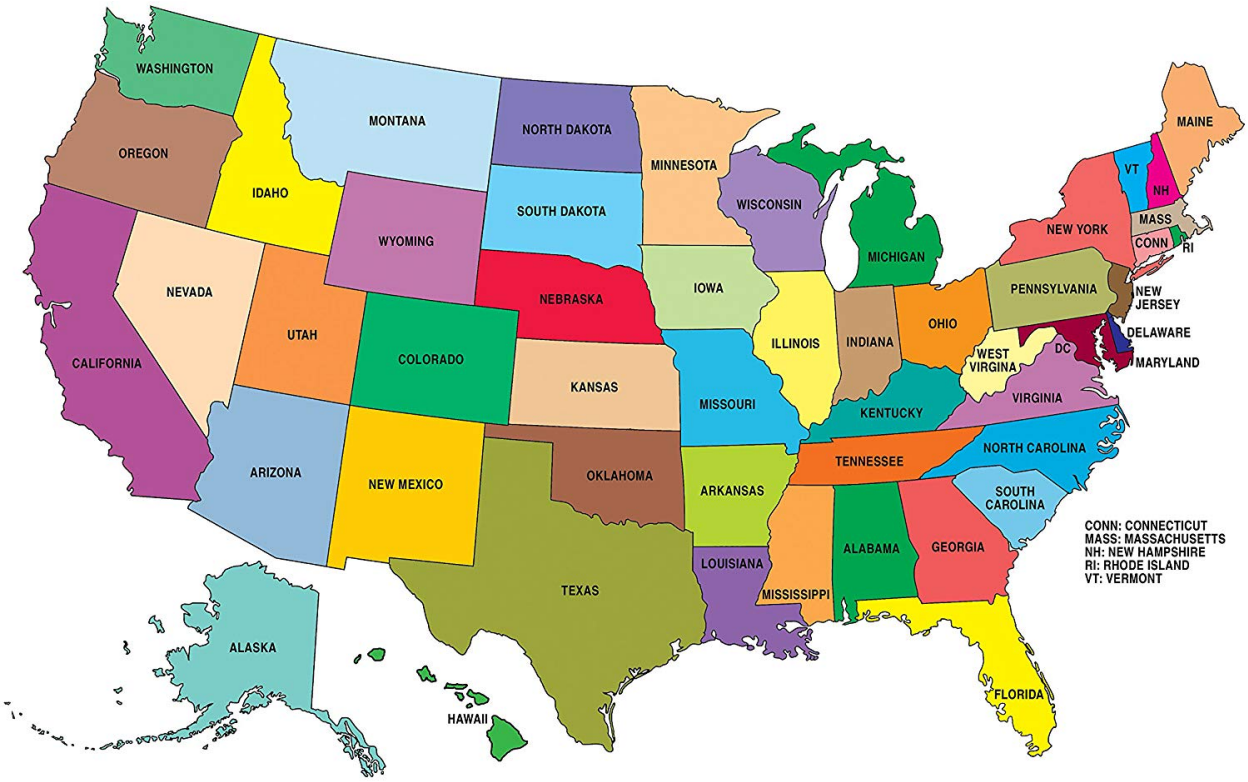
2020

State Laboratory Program Workload Survey



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Foreword

Greetings metrologists from the State Laboratory Program (SLP) Workload Survey Team. It is again our please to present the 2020 State Laboratory Program Workload Survey. Many thanks go to the survey team for collecting and compiling survey data; to the National Institute of Standards and Technology (NIST) Office of Weights and Measures staff for providing reports on the activities of the Laboratory Metrology Program at NIST and for hosting the SLP surveys both past and present on their websites; and to the many metrologists who collect the data necessary for this survey. It is your support that makes this publication a valuable reference for all of us. Special thanks go to Van Hyder and Georgia Harris for the time, expertise, and effort they devote to both this survey and to our profession in general.

It's hard to think of appropriate words for this survey in light of the challenges we've all faced over the past couple of years in response to COVID-19. We have had to adapt to an array of new safety procedures in the lab, in our offices, and in our communities to control the spread of COVID-19 while we raced to make vaccines available to the public. We've all become accustom to face masks, social distancing, an array of surface sanitation products, daily reminders to take steps to reduce the spread of the disease, and the accompanying frustration and fatigue that accompanies the upheaval of all things "normal". In light of this I'm thankful that our respective metrology laboratories could continue providing measurement services to the industry and regulatory programs whom we continued to support through this pandemic and I'm thankful that we were able to publish a survey this year all things considered!

Our sympathies go out to those who lost friends and loved ones to COVID-19 these past couple of years.

Be safe everyone,

Steven Harrington
Oregon Department of Agriculture
635 Capitol Street NE
Salem, OR 97301
steven.harrington@oda.oregon.gov

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Acknowledgements

This report was prepared with the help of the members of the NCSL International Committee 156 - Legal Metrology Committee. Special thanks must be given to all the metrology professionals working in the State Laboratory Program who have generously given their time to complete the 2020 State Program Workload Survey thus providing the data essential to make this report possible. Thanks also go to the staff of the National Institute of Standards and Technology, Office of Weights and Measures who have provided considerable support in collecting data and preparing and publishing this report.

It is our sincere hope that this biannual report continues to be a valuable resource to the State Laboratory Program laboratories and to those who use the service that these laboratories provide.

Objectives and History

Historically there has been inconsistency between survey titles and the year which data represents. Starting in 2008 the survey team adopted a convention of naming the report based upon the year which the data represents rather than the year the report was published. For example, the report titled “2008 State Laboratory Program Workload Survey" represents data collected during the 2008 calendar year. Table 1 correlates historical workload surveys to the year(s) during which the data was collected.

Survey Title	Year represented
1996 State Laboratory Program Workload Survey	1996
1999 State Laboratory Program Workload Survey	1998
2000 State Laboratory Program Workload Survey	1999
2001 State Laboratory Program Workload Survey	2000
2003 State Laboratory Program Workload Survey	2002
2005 State Laboratory Program Workload Survey	2004
2005 & 2006 State Laboratory Program Workload Survey	2005&2006
2008 State Laboratory Program Workload Survey	2008
2010 State Laboratory Program Workload Survey	2010
2012 State Laboratory Program Workload Survey	2012
2014 State Laboratory Program Workload Survey	2014
2016 State Laboratory Program Workload Survey	2016
2018 State Laboratory Program Workload Survey	2018
2020 State Laboratory Program Workload Survey	2020

Table 1: Historical survey titles and the year represented by each.

In 1996, the National Conference on Weights and Measures (NCWM) Metrology Subcommittee surveyed the State Laboratory participants to quantify the workload of the State Laboratory Program (SLP) and document its impact on the United States economy. From the survey analysis, it was clear that the workload statistics were dynamic and only provided a snapshot of the workload at the time. Therefore, the Metrology Subcommittee circulated a revised survey April 16, 1999 to update program statistics and to investigate trends in the National workload. The subcommittee has since recommended that the survey be conducted on a regular basis and that the core survey be kept standardized in order for state labs to develop databases that could automatically generate the information for the survey.

Survey data is used not only to quantify the impact of the SLP on the United States economy, but also to plan and maximize its effectiveness. Training and inter-laboratory comparisons are designed to meet real needs of the workload. Ultimately, the survey information increases the efficiency of the entire SLP and maximize the benefits to the national economy. The results of previous surveys have been used extensively at NIST to gain support and attention for the State Laboratories and have been helpful in putting together budget proposals. The information from the survey is also useful in identifying the diversities of the workload on a national level.

Collection, Presentation, and Analysis of Data:

SLP laboratories submitted their data using standardized Microsoft Excel spreadsheets.

The data was copied from each individual completed survey forms into a master workbook for analysis. The copy process is automated using Excel macros in order to expedite the process and to minimize the potential for random data transcription errors.

The overall survey is presented in the following order;

1. The NIST Office of Weights and Measures (OWM) provides an initial report of workload data from the NIST Measurement Services Division summarizing calibration work done for State laboratories covering a range of measurements including mass, volume, temperature, pressure, etc. This report generally presents the leveraging effect that the SLP provides for the NIST Measurement Services Division. The NIST report begins on page 15.
2. The NIST OWM provides an overview of the SLP which;
    - details program metrics NIST OWM uses to track member laboratories,
    - reports on the accreditation status of each of the member laboratories,
    - reports on training provided by NIST OWM for the member laboratories,
    - reports on proficiency testing conducted within the SLP,
    - reports on documentary standards used by the SLP,
    - details each member laboratory's measurement scope as recognized by NIST OWM.
3. Individual laboratories participating in the survey are identified by name location, age, size, and number of customers served beginning on page 32. Current contact information for the individual SLP laboratories and their NIST OWM Certificate of Measurement Traceability can be found on the NIST Office of Weights and Measures website:

    https://www.nist.gov/pml/weights-and-measures/resources/state-laboratories-c.
4. Each laboratory's prior survey participation in previous surveys is reported beginning on page 37.
5. The SLP workload portion of the survey is broken down into four broad measurement categories; mass, length, volume, and other. Each category is further subdivided into three sub-categories identifying the type of customer for whom measurements are performed; laboratory, weights and measures enforcement, and external.

    The data is presented in the form of both choropleth maps, color coded to illustrate the distribution of work across the entire SLP, and bar charts, ordered from high to low displaying the number of tests performed by each member laboratory. Summary pie graphs are included to report totals across the entire SLP by customer type.

    Summary data from previous workload surveys are included for each measurement category covered in this survey for comparison purposes. Mass testing data begins on page 41, Length on page 55, Volume on page 60, and all other tests on page 76.

6. A report of fees charged for the various services provided by each member lab begins on page 89. Fee estimates for a range of routine measurement services are presented using bar graphs detailing individual laboratory fee estimates. Historical averages are included for each measurement service where the data is available.
7. A report of laboratory staffing begins on page 122. This report includes;
    - Position titles;
    - Salary ranges; and
    - Detailed list of metrologists employed in the SLP at the time of the survey. The data includes specific calibration authorizations, experience in years, and the approximate dates each person is eligible for full retirement.
8. Each laboratory is asked to identify from whom they will accept calibration certificates on page 141. Member laboratories often have a regulatory duty with respect to service personnel who are normally required to submit measurement equipment for calibration on a regular basis. The acceptance matrix identifies from whom a service company can purchase a calibration certificate which will then be given legal recognition within that member laboratory's jurisdiction.
9. Each year the survey team prepares a section of supplementary questions which, unlike the previous sections, changes significantly from year to year. This section begins on page 143.
10. Survey participants are invited to add comments to help clarify their responses to each of the survey questions. Survey comments are listed in this report beginning on page 146.
11. A reprint of the 2018 survey begins on page 156.

Additional Comments:

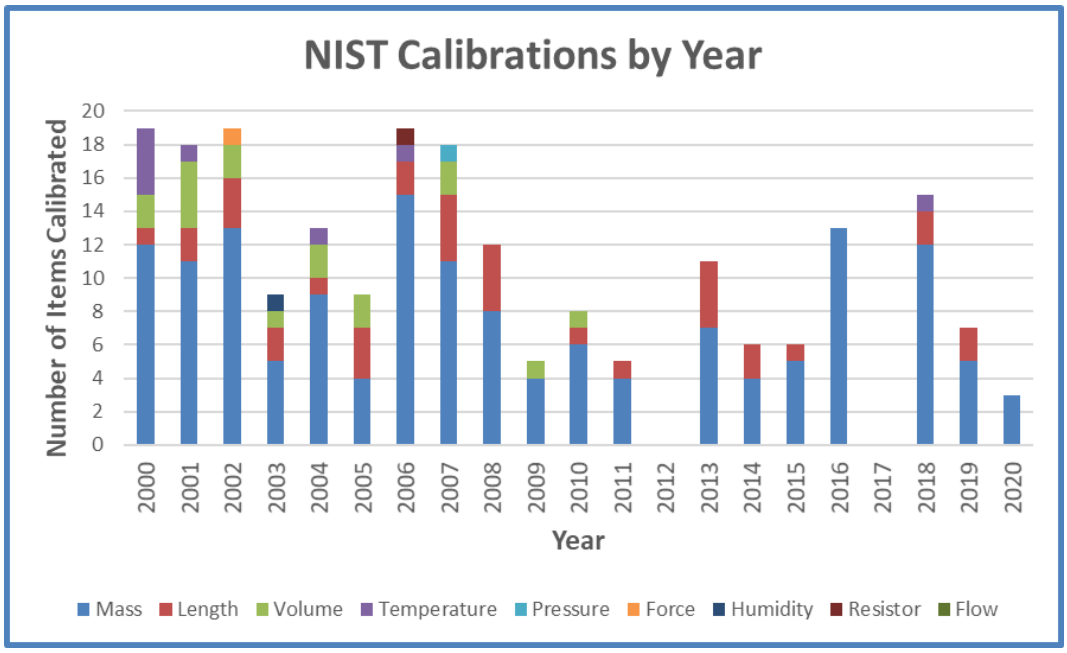
Caution should be used when comparing one state's data with data to another. It was determined in the 1996 survey that laboratory workload is influenced by industrial and population densities that vary by geographical location. Thus, low numbers for a lab may simply reflect low local demand for a laboratory's service. Variance in the number of devices tested, staffing, and facilities between individual laboratories are normal and cannot legitimately be used to rate the quality of any laboratory program.

No attempt was made to analyze the change in the workload of individual laboratories due to cyclic nature of the work. For example, a member laboratory may measure their volumetric glassware on a two-year calibration interval with the majority of these standards calibrated in sync with each other. The consequence being that few are tested in the following twelve-month period. This does not indicate that the workload is decreasing, it is just a reflection of the calibration interval assigned to those standards.

Impact and Leveraging of NIST Calibrations

(Information provided by NIST/OWM)

Calibration data for State laboratories was obtained from the NIST Measurement Services from 2000 through 2020. One of the measures of impact of NIST calibrations is to quantify the number and impact of downstream calibrations. How many additional calibrations are made by other laboratories using these calibrations? The answer to this question is a measure of the national impact of NIST calibration services and training. This leveraging of NIST calibrations to industry by the State weights and measures laboratories contributes greatly to the economy of the United States.

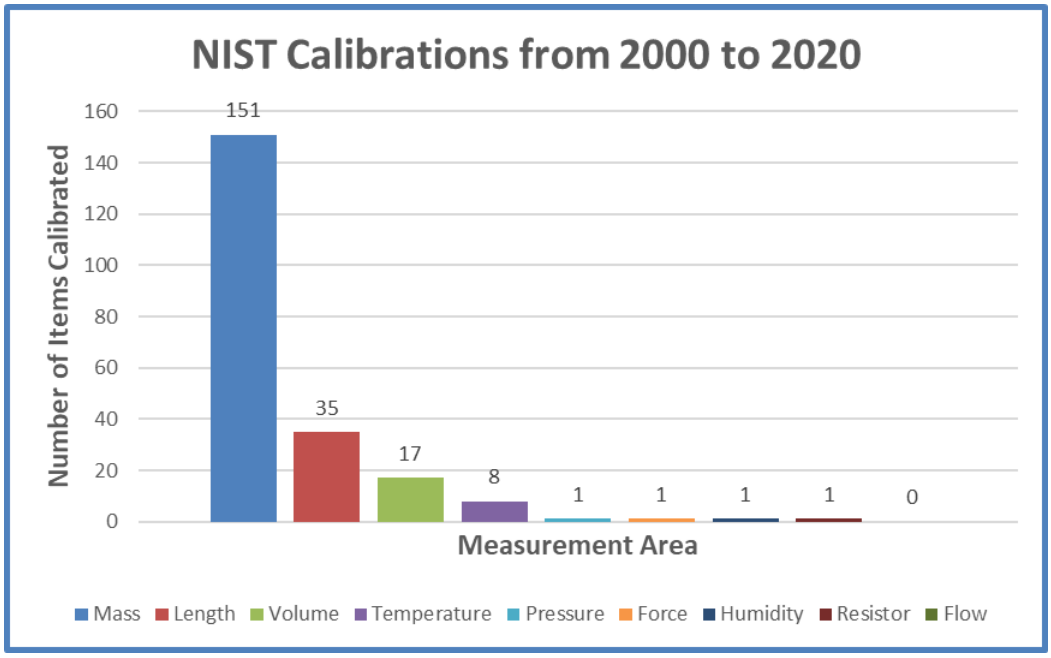


Data in the current survey includes measurements and calibrations performed at NIST in non-traditional measurement areas (e.g., those outside of mass, length, and volume).

State weights and measures laboratories account for a small portion of NIST's annual calibrations. Given data obtained in the Laboratory Program surveys in the 1990's, typically about half of the customer workload in the State laboratories is for industry and other government agencies (i.e., not weights and measures enforcement efforts). Many of these customers are the same customers who in other countries must obtain calibrations from a National Metrology Institute (NMI) such as NIST.

Economic statistics indicate that weights and measures enforcement, supported by these leveraged State weights and measures laboratory calibrations, affects more than half of the $20.93 trillion (2020) Gross Domestic Product (GDP). Since nearly half of the State weights and measures laboratory workload does

not affect weights and measures enforcement, the economic impact of these calibrations influences virtually all of the U.S. GDP. Accurate measurements ensure product quality for practically every product manufactured, are required for other regulatory functions (EPA, FDA, DOD, DOE, DOT), and are requisite for international trade.



One question that might be asked in looking at this kind of leveraging data is "are enough calibrations being obtained from NIST by the States?" One responsibility of the NIST Office of Weights and Measures (OWM) is to coordinate the Laboratory Metrology Program. Each state laboratory that is recognized by OWM or accredited by NVLAP is required to have calibrations from acceptable sources, which are most often from NIST or other accredited laboratories. OWM Recognition or NVLAP Accreditation ensures that enough calibrations are obtained from NIST by the State weights and measures laboratories and that the State metrologists are trained adequately. Furthermore, metrologists must prove their competency/proficiency and have specified calibration intervals for laboratory standards to ensure the ongoing ability to provide calibration results that are traceable to SI units or international and national standards. The number one corrective action following failed PTs/ILCs is that of obtaining updated calibrations for laboratory reference standards. It is estimated that better than 96 % of the laboratory standards are calibrated in a timely manner according to established calibration intervals.

Metrological traceability and its assessment are required to comply with seven essential elements to ensure traceability to the International System of Units (SI) – typically, though not always through NIST. The seven essential elements are 1) defining the measurand and realization of the measurements to the International System of Units (SI) 2) a documented unbroken chain of comparisons (calibrations), 3) documented and up to date calibration program, 4) documented and suitable measurement uncertainties, 5) use of documented and validated procedures, 6) demonstrated technical competence/proficiency, and 7) an acceptable measurement assurance system to ensure the validity of the measurement results. In addition, State laboratories are required to comply with State laws regarding traceability to the SI (or as stated, to

National Institute of Standards and Technology) and through adoption of NIST publications like NIST Handbook 44: Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices - Current Edition, and NIST Handbook 130: Uniform Laws and Regulations in the Areas of Legal Metrology and Engine Fuel Quality - Current Edition, they also must ensure compliance of measurement standards to appropriate/suitable specifications and tolerances for use in legal metrology.

Handbook 130 uniform laws allow for obtaining calibrations from suitable suppliers, as an alternative to direct NIST calibrations, when there is acceptable evidence of recognition and/or accreditation, suitable calibration and measurement capabilities (measurement, range, uncertainties) to ensure compliance with technical requirements of metrological traceability.

NIST Office of Weights and Measures (OWM)

Laboratory Metrology Program Overview

One of NIST's primary responsibilities is to ensure that uniform standards are available to support the nation's measurement infrastructure. As documented in the last edition of the workload survey, State laboratories provide the foundation for over 325,000 calibrations as a critical part of the U.S. measurement infrastructure. Approximately half of these calibrations support commercial weights and measures with the remaining supporting measurements needed by industry and other government agencies. NIST will be successful if measurement results from State laboratories are accurate, traceable, defensible in support of enforcement actions, and widely accepted (both nationally and internationally.)

Four Interrelated Program Areas

There are four key areas of responsibility in the OWM Laboratory Metrology Program in support of ensuring the capability of laboratories to provide traceable measurement results: Laboratory Recognition, Proficiency Testing, Training, and Field Standards for Weights and Measures documentary standards (Figure 1). Each functional area has a set of guiding documents as well as international documentary standards used for benchmarking to enhance program recognition and credibility.

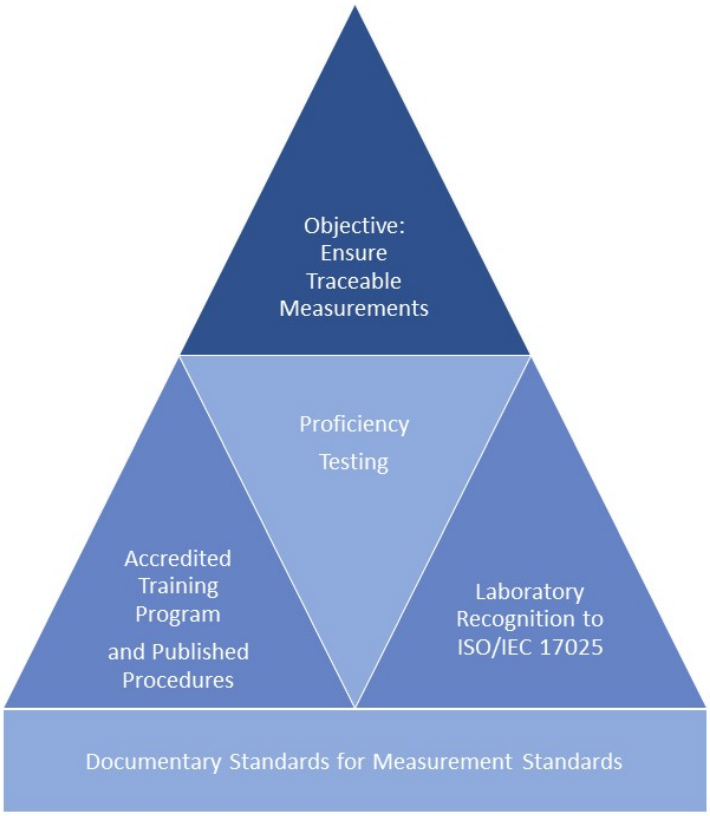


Figure 1. Laboratory Metrology Program Areas.

All areas are interrelated with the other areas. For example, laboratories that are recognized often support the weights and measures program requirements to ensure that measurement results have demonstrated metrological traceability while the Handbook 105-series documentary standards are often required by the weights and measures program for enforcement applications. The laboratory recognition area is very narrow in scope and only supports weights and measures laboratories in the U.S. To be recognized, the laboratory must successfully complete both training and proficiency testing requirements, in addition to all other published requirements that follow the ISO/IEC 17025 standard for calibration laboratories. Training on both proficiency testing and laboratory recognition requirements is available. Proficiency testing is used not only to assess laboratory competency for recognition and accreditation but assesses the level of impact and application of training concepts.

Program Measures:

Program measures for the four areas include the following items to assess ongoing program improvements (or declines and areas for needed focus). Graphic examples are included in each section to present the association measures.

1. Number of laboratories recognized by the Weights and Measures Division complying with NIST Handbook 143, Program Handbook.
2. Laboratory Scoring Model measures changes in the national system over time with a key INDEX value according to elements of the Program Handbook.
3. Number of laboratories accredited by NVLAP (third-party independent assessment of compliance to ISO/IEC 17025 criteria) to NIST Handbook 150, NVLAP Program Handbook.
4. Number of staff completing training requirements as noted in NIST Handbook 143, Program Handbook.
5. Percentage of acceptable/passing proficiency test results and increasing percentage of effective follow up action (improvement, preventive, and corrective).
6. Updated publications.

Program Area Descriptions

Laboratory Recognition

Laboratory recognition is provided for the weights and measures laboratories to help demonstrate evidence of metrological traceability that is required in the States and local jurisdictions. Handbook 130, model weights and measures law, as adopted in the jurisdictions, states that weights and measures programs are required to ensure metrological traceability to the International System of Units (SI) normally through NIST. The latest model law indicates that laboratory recognition or Accreditation provides the demonstrated evidence of metrological traceability. Some value-added impacts of the OWM laboratory recognition over accreditation alone is that OWM can target specific technical areas each year when and where problems have been identified, as well as conduct national-level analysis to assess and consider system-wide needs. Annual assessments are conducted for all laboratories and periodic resources are posted on the NIST website related to annual assessments. Example technical assessments that have provided national level assessments in the past few years include facility assessments, software verification and validation, succession planning, measurement assurance, uncertainties, and metrological traceability. Identified problems provide input into the training area. The laboratory

recognition program required all states to meet the requirements of the latest ISO/IEC 17025 standard by the end of 2020.

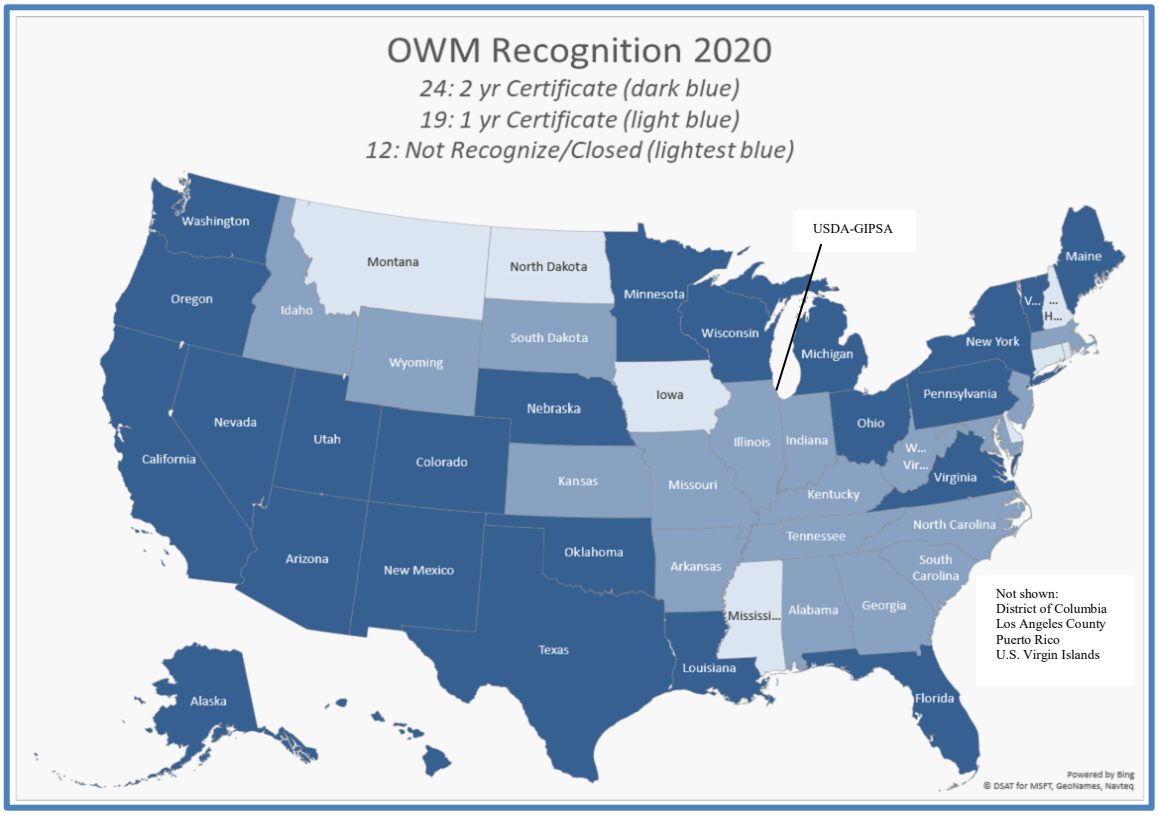


Figure 2. Laboratory Recognition by OWM (2020 December).

Laboratory Scoring Model

A laboratory scoring model was developed in 2006 and is based on assigning numerical values to each laboratory in several categories that correspond to NIST Handbook 143. Points are awarded in the following categories to each laboratory:

- Quality Management System
- Administrative Procedures
- Facility
- Equipment
- Standards
- Staff
- Management Support
- Proficiency Tests (PTs)
- Extra Credit – Timely Submissions
- Multipliers (NVLAP accreditation with 2-year OWM recognition, 2.5; NVLAP accreditation with 1 year OWM recognition, 2.25; OWM, 2 year recognition, 2; OWM, 1 year recognition, 1.5; OWM, 1 year conditional recognition, 1; No recognition, 0.5; Lab Closed, 0).

The model is intended to provide a quality index to the overall laboratory program. The scoring model was updated in 2008 based on laboratory feedback and the first two years of use. The scoring model is used internally at NIST to identify where resources and efforts will be allocated. The current "top score" possible (success goal) is 275. Laboratories that are fully successful with OWM 2-year Recognition generally score between 140 and 220.

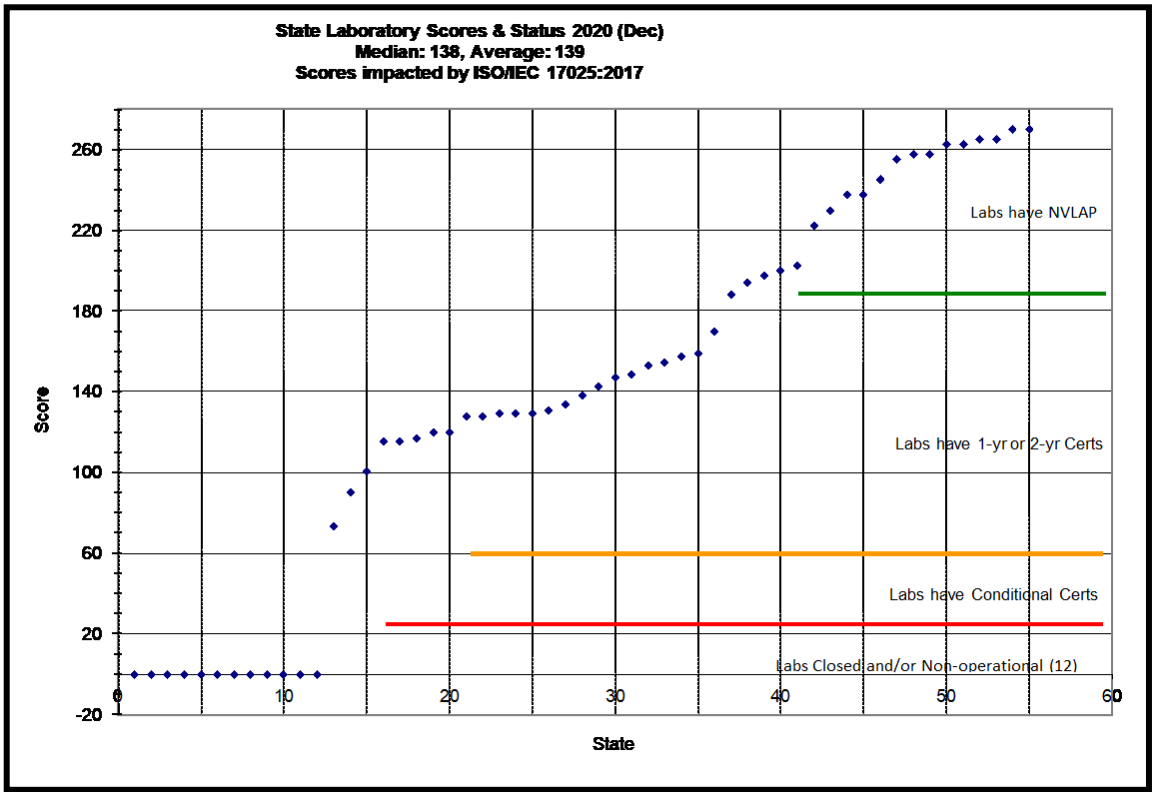


Figure 3. Laboratory Scoring Model (2020 December).

Scoring Model Trends

The OWM goal is to see the laboratory scores increase (or at least remain stable). Note: At this time, specific coding is not provided for identifying laboratories. In the latest assessment, we noted that several laboratories that were previously recognized and accredited have lost staff and not had adequate succession planning in place to keep laboratory recognition and/or accreditation in place or in place at the levels prior to staffing changes. In the 2019 to 2020 time frame the COVID-19 pandemic impacted some laboratories timely plan to relocate to a new or renovated laboratory and succession planning. In addition, the end of 2020 deadline for recognized laboratories to comply with the ISO/IEC 17025:2017 standard played a role in the scoring. Training on the new ISO/IEC standard has been provided since 2016 and in anticipation of the changes to the standard so that 43 out of 47 (92 %) active laboratories were able to demonstrate compliance with the new standard.

Table 2. Laboratory Scoring Model Trends.

Year	Median	Mean
Successful Goals	140 to 220	140 to 220
Accreditation Goals	220+	220+
2006	97.5	130
2007	140	140
2008	172	156
2009	172	156
2010	168	154
2012	168	156
2014 (end)	143	149
2016	186	169
2018[a]	126	131
2020	138	139

[a] Major adjustment due to use of 1-year interval for all laboratories with transition to ISO/IEC 17025:2017.

Laboratory Accreditation

The last measure of assessment in the recognition area that is presented here is the laboratory accreditation status through the NIST National Voluntary Laboratory Accreditation Program (NVLAP). The OWM Laboratory Metrology Program interfaces with NVLAP for those state laboratories that are accredited.

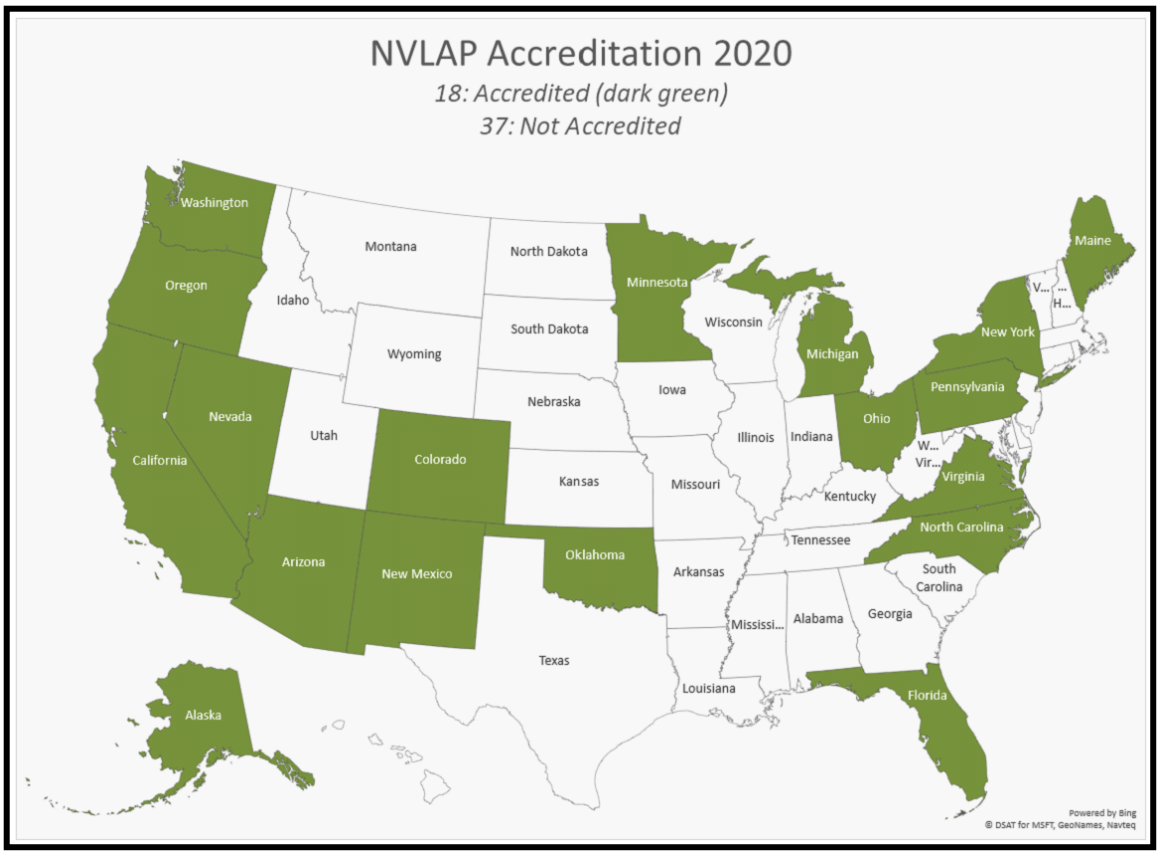


Figure 4. NVLAP Accreditation of State W&M Laboratories

Within NVLAP, the current primary contact for state laboratories is Kari Harper. The primary contact in OWM for this area is Micheal Hicks.

Training

Training includes courses that are taught at NIST in the OWM Training Laboratory, regionally at the Regional Measurement Assurance Program (RMAP) annual training sessions (Figure 5), and online as a webinar.

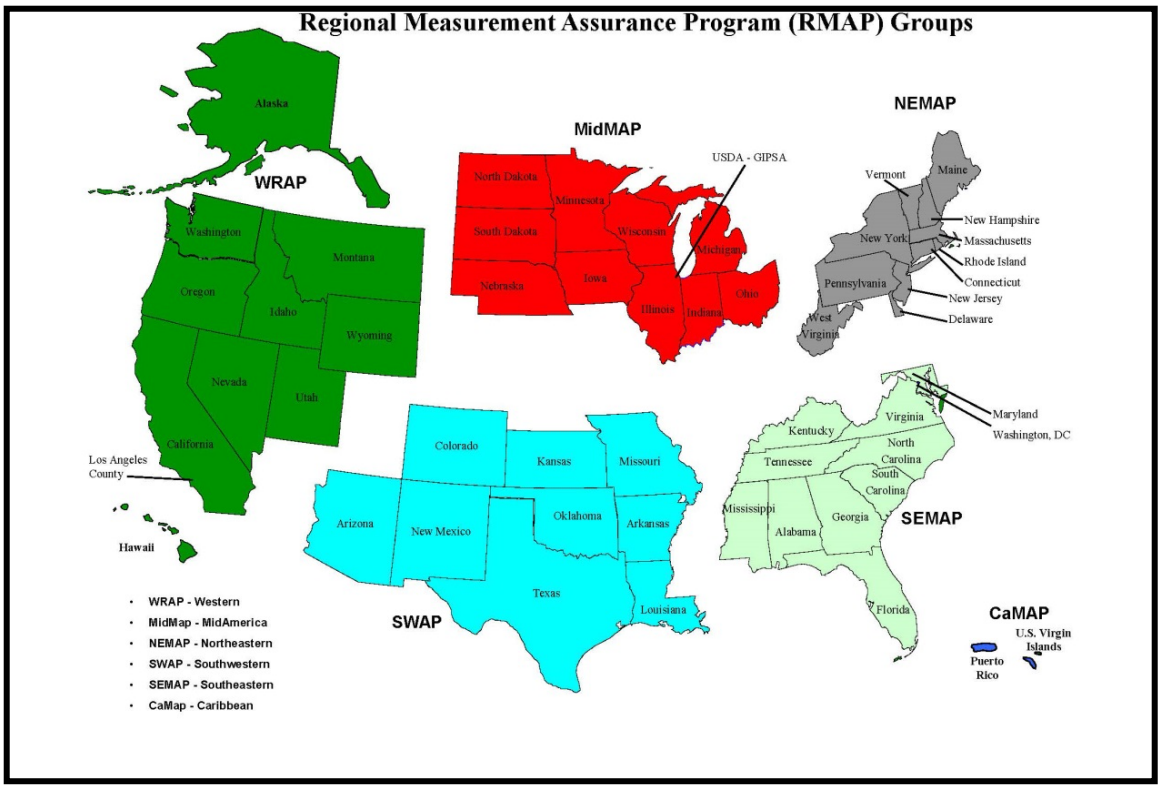


Figure 5. Regional Measurement Assurance Program (RMAP) Groups.

The core laboratory metrology courses/seminars that are offered by OWM at NIST include: Fundamentals of Metrology, Mass Metrology, Volume Metrology, and Advanced Mass Metrology. These courses were developed and updated over the past few years as a part of a training redesign project to ensure that all training requirements needed by the laboratories are covered as well as to integrate more activities and adult learning concepts into the courses as a part of the goal of maintaining an accredited training program. Previous courses (Basic Metrology for States, Intermediate Metrology) are no longer available. In addition to the traditional hands-on training courses, the OWM Laboratory Metrology Program has developed a series of 2-hour webinars on a variety of high interest topics. The seminar and webinar tuition is funded by the OWM for U.S. weights and measures officials and metrologists to enhance legal metrology uniformity.

Specific training and personnel competency requirements to support laboratory recognition are published in Handbook 143 with interim updates published on the NIST OWM website. Training at the RMAP sessions is selected each year based on training needs assessments with input gathered through laboratory requests and inquiries, assessments of annual submissions from the laboratories, and through assessment of reasons for proficiency testing failures.

The COVID-19 pandemic resulted in NIST OWM canceling all in-person training starting March 2020 through the remainder of the year. RMAP training delivery was modified to an online method. All NIST OWM core training seminars were suspended pending the reopening of the NIST campus. The impact of the suspension of the core training in 2020 can be seen in the relatively low scoring model average for the 2020 Recognition Reviews. To partially compensate for the suspension of the training seminars, NIST OWM developed an interim online course

titled Fundamentals and Laboratory Auditing Program (LAP) Problems Preparation in 2020. This online course covers the principles taught in the Fundamentals of Metrology, with content from one Mass Metrology procedure and one Volume Metrology Seminar procedure. The course trains new staff on the basics of Metrology and the lower echelon methods of Mass and Volume Metrology. After completing this online course, new staff will still be required to take the core training seminars once the NIST campus reopens for on-site training. In addition to the pandemic, the training program has been impacted by the departure of three full-time staff members; two from retirement and one from reassignment to another program. In response, the program has hired a new staff member, reassigned another staff member of OWM to the program, and rehired the retirees as part-time annuitants. The program is also utilizing contractors, including experienced staff from state laboratories, to help instruct the training courses.

Numerous supplementary courses are taught throughout the year as webinars covering many topics related to implementing content from Handbook 143 or to address training needs between other seminars that are scheduled. Registration for all courses is done through the NIST OWM Contact Management System database with transcripts readily available to students. The primary contacts for the OWM Contact System is Yvonne Branden.

Training courses (seminars and webinars) for 2011 through 2020 in metrology are summarized in Figures 6 and 7. New in 2016 were the addition of "Laboratory Metrology Info Hour" (LMIH) sessions. These are short, 1-hour, recorded sessions, no pre-work, no post-work, no certificates, to provide updated news and current events. These are sessions for weights and measures staff only and can support up to 98 participants per session. The primary contact for the training program is Isabel Chavez Baucom.

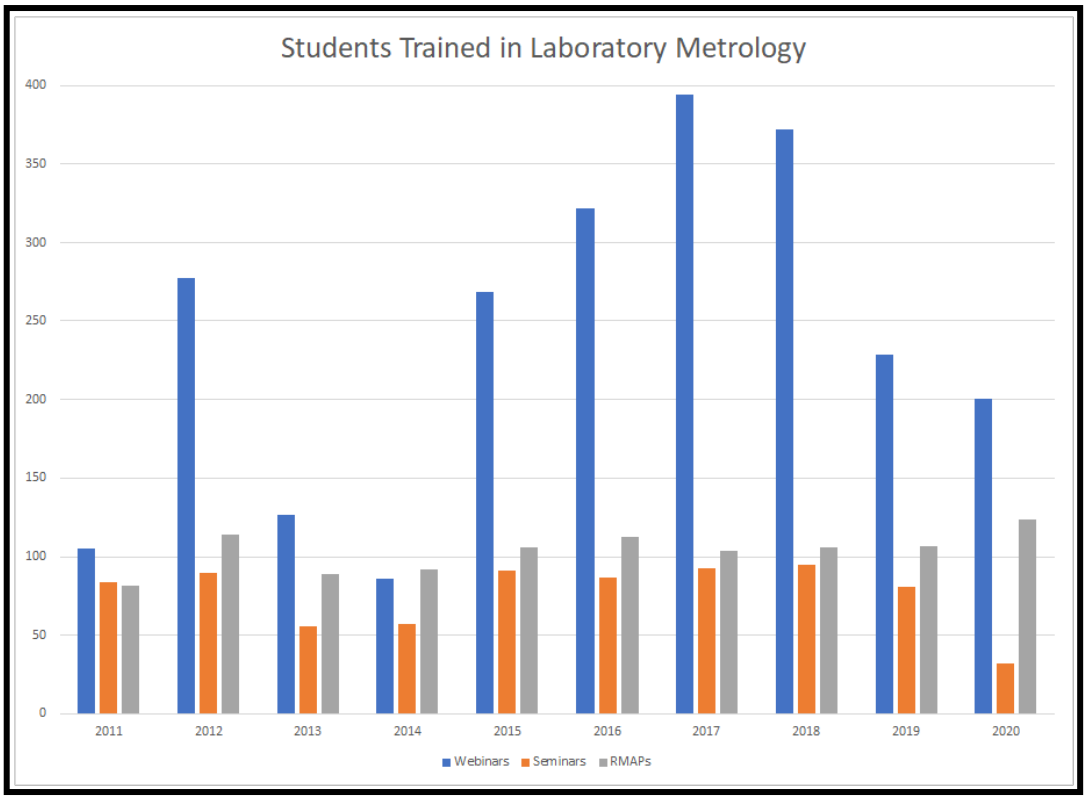


Figure 6. Laboratory Metrology Students Trained for 2011 through 2020.

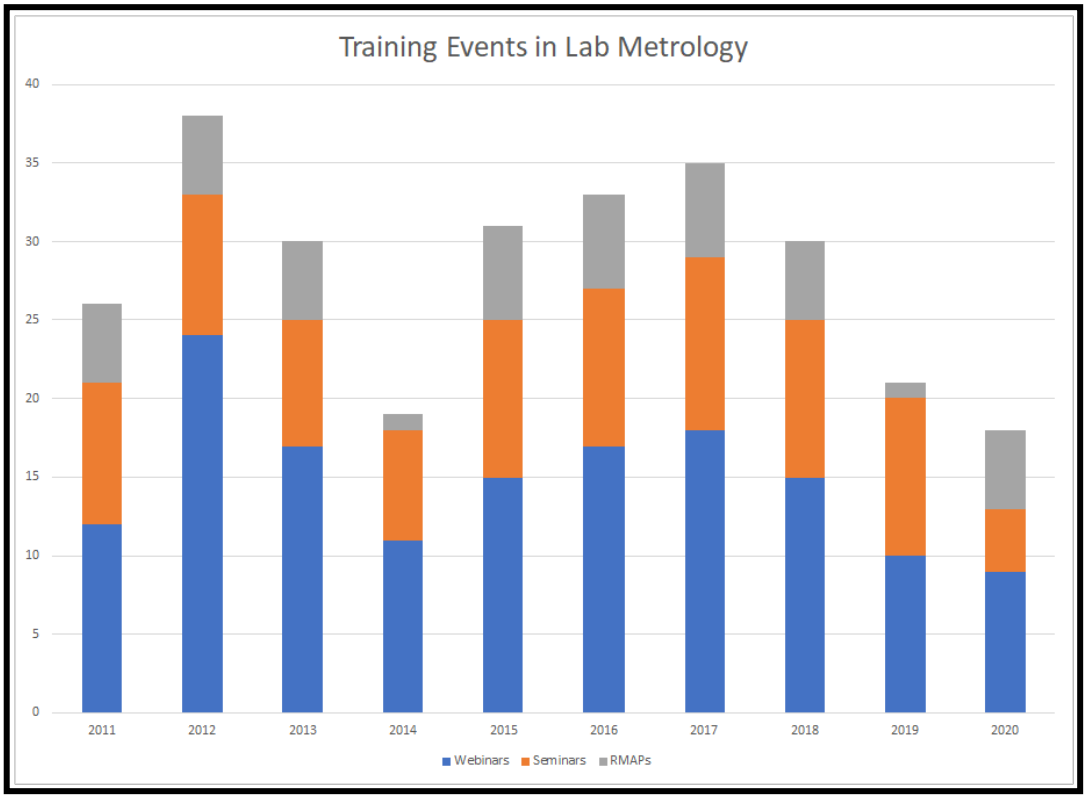
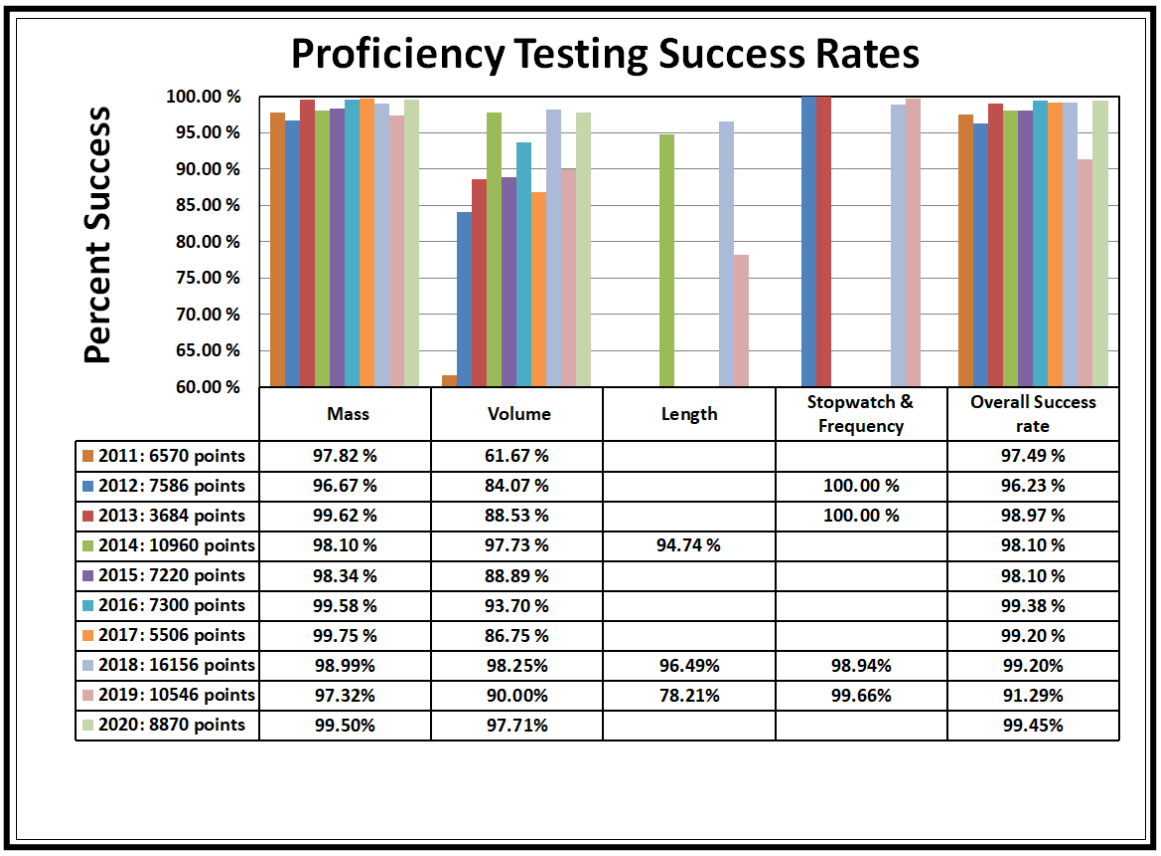


Figure 7. Laboratory Metrology Training Events for 2011 through 2020.

Proficiency Testing

The proficiency testing area is primarily coordinated through the annual RMAP training sessions. A 4-year plan is developed within each RMAP group to support the need for laboratories to have a 4-year plan and comply with recognition and accreditation policies. The planning, analysis, and reporting takes place at each meeting, where laboratories are given opportunities to help create the plan to meet the needs of their measurement scopes as well as providing an opportunity to minimize overall program costs through volunteering to coordinate and analyze data.



	Mass	Volume	Length	Stopwatch & Frequency	Overall Success rate
2011: 6570 points	97.82 %	61.67 %			97.49 %
2012: 7586 points	96.67 %	84.07 %		100.00 %	96.23 %
2013: 3684 points	99.62 %	88.53 %		100.00 %	98.97 %
2014: 10960 points	98.10 %	97.73 %	94.74 %		98.10 %
2015: 7220 points	98.34 %	88.89 %			98.10 %
2016: 7300 points	99.58 %	93.70 %			99.38 %
2017: 5506 points	99.75 %	86.75 %			99.20 %
2018: 16156 points	98.99%	98.25%	96.49%	98.94%	99.20%
2019: 10546 points	97.32%	90.00%	78.21%	99.66%	91.29%
2020: 8870 points	99.50%	97.71%			99.45%

Figure 8. Proficiency Testing Success Rates (2011 to 2020).

Proficiency testing and interlaboratory comparisons (PTs/ILCs) have been conducted in the Regional Measurement Assurance Program (RMAP) regions since the early 1980's. NIST has captured the number and types of PTs/ILCs since that time. However, measures for evaluating proficiency testing results have been modified since 2006. Over 100,000 status points have been collected since pass/fail data has been collected. NIST began capturing pass/fail statistics for all PT/ILC results and compiling them by measurement parameter. This allows NIST to evaluate the effectiveness of training efforts and use of uniform calibration procedures among laboratories and to see improvements (or declines) over time. It also provides information on where to dedicate effort and resources in additional training and follow-up efforts.

Overall, based on the 10-year of PT assessments above, over 85,000 evaluation points of normalized error (E_n) and normalized precision (P_n) have been assessed in the listed measurement areas. Laboratories are making good progress towards reaching the success goal of 100 % passing rate and 100 % completed follow-up when needed. Program planning, analysis and reporting tools used in the PT program are used by many other laboratories outside the program and outside the United States. Micheal Hicks is the primary contact in this area.

Documentary Standards

Ideally, documentary standards would be reviewed at least every five years and updated as appropriate. This area of the program receives the least overall attention, but standards are selected for updates when issues arise indicating a need. Currently, an update to NIST Handbook

105-7 for small volume provers is in the development process. A new standard is being considered for master meters along with an update to 105-2 for field standard measuring flasks. Handbook 105-1 for field standard weights and Handbook 105-8 for weight carts were both updated in 2019. Handbook 105-4 for LPG provers was updated in 2016. The program also participates with ASTM, USP, and OIML standards development. Val Miller is currently the primary contact for Handbook 105-1, and ASTM updates and Georgia Harris for the volumetric standards.

Program References

An intentional effort has been made by the OWM Laboratory Metrology Program – at least since the 1980's – to adopt and use international standards and references to gain program credibility. For example, when NIST Handbook 143 was first published in 1986, it referenced ISO Guide 25 and Handbook 145 procedures referenced Mil-Std-45662A. Both ISO Guide 25 and Mil-Std-45662A were the internationally and nationally accepted standards at that time. Yet, full implementation of these and their current standard counterparts has taken time. The first documented guidance in the proficiency testing area followed ISO Guide 43, which has since become a formal standard rather than a guide with compliance to ISO/IEC 17043. Handbook 143, Program Handbook was drafted during 2018 and published in 2019 to adopt ISO/IEC 17025:2017.

Table 3. Program Area Reference Documents.

Topic	Publication Type and Number	Title	Latest Revision Date
Recognition	Handbook 143[i]	State Weights and Measures Laboratories Program Handbook	2019
Accreditation	Handbook 150-2[ii]	NVLAP Calibration Laboratories	2019
Accreditation	Handbook 150-2, Annex A	Annex A: ANSI/NCSL Z540-1-1994, Part I (normative)	2019
Accreditation	Handbook 150-2, Annex B	Annex B: Dimensional measurements (normative)	2019
Accreditation	Handbook 150-2, Annex C	Annex C: Time and frequency measurements (normative)	2019
Accreditation	Handbook 150-2, Annex D1	Annex D: Mechanical measurements (normative), D1 Force Calibrations	2019
Accreditation	Handbook 150-2, Annex D2	Annex D: Mechanical measurements (normative), D2 Mass calibrations	2019
Accreditation	Handbook 150-2, Annex D3	Annex D: Mechanical measurements (normative), D3 Volume calibrations	2019
Accreditation	Handbook 150-2, Annex E	Annex E: Requirements for NVLAP-accredited legal metrology laboratories	2019

Topic	Publication Type and Number	Title	Latest Revision Date
Mass Calibration Lab Procedures	NISTIR 5672	Advanced Mass Calibrations and Measurements Assurance Program for the State Calibration Laboratories	2019
Mass Calibration Lab Procedures	NISTIR 6969	Selected Laboratory and Measurement Practices, and Procedures to Support Basic Mass Calibrations	2019
Volume Calibration Lab Procedures	NISTIR 7383	Selected Procedures for Volumetric Calibrations	2019
Length Calibration Lab Procedures	NISTIR 8028	Selected Laboratory and Measurement Practices and Procedures for Length Calibrations	2014
Weights and Measures Lab Procedures	NISTIR 8250[iii]	Calibration Procedures for Weights and Measures Laboratories	2019
Proficiency Testing	NISTIR 7082	Proficiency Test Policy Plan	2018
Proficiency Testing	NISTIR 7214[iv]	Weights and Measures Division Quality Manual for Proficiency Testing and Interlaboratory Comparisons	2005
Field Standards	Handbook 105-1	Specifications and Tolerances for Field Standard Weights, (NIST Class F) (available for Historical purposes)	1990
Field Standards	Handbook 105-1	Specifications and Tolerances for Field Standard Weights, (Ref OIML R111 and ASTM E617)	2019
Field Standards	Handbook 105-2[v]	Specifications and Tolerances for Field Standard Measuring Flasks	1996
Field Standards	Handbook 105-3	Specifications and Tolerances for Graduated Neck Type Volumetric Field Standards	2010
Field Standards	Handbook 105-4	Specifications and Tolerances for Liquefied Petroleum Gas and Anhydrous Ammonia Liquid Volumetric Provers	2016
Field Standards	Handbook 105-5	Specifications and Tolerances for Field Standard Stopwatches	1997

Topic	Publication Type and Number	Title	Latest Revision Date
Field Standards	Handbook 105-6	Specifications and Tolerances for Thermometers	1997
Field Standards	Handbook 105-7[vi]	Specifications and Tolerances for Dynamic Small Volume Provers	1997
Field Standards	Handbook 105-8[vii]	Specifications and Tolerances for Field Standard Weight Carts	2019
Notes	[i] Handbook 143, Table 2 was updated in 2021. Additional updates are anticipated due to incomplete references in the NVLAP Handbook Annexes regarding Echelon categories. Additional annexes may be referenced as they are developed (e.g., for thermometry and thermodynamic measurements). [ii] NVLAP Handbook 150-2 for Calibration Laboratories and all Annexes are referenced in Handbook 143 as requirements for Weights and Measures Laboratories. Technical criteria were published as duplicates prior to the 2019 versions. For the 2019 publications, Handbook 143 explicitly references the NVLAP technical criteria. Associated checklists are applicable for internal auditing and assessor evaluations as well. OWM staff contribute to technical and editorial review of the applicable NVLAP annexes. [iii] Additional procedures available in draft form to be formatted, validated, and published as part of this NISTIR in the future. See the table of contents for works to be completed in the future. [iv] Updates expected to ensure compliance with ISO/IEC 17043 upon next revision (to ensure compliance and consistency with ISO/IEC 17025.) [v] Decision rule criteria to be updated in this publication. Currently specified as uncertainty required to be less than one-third applicable tolerances (maximum permissible errors). Updates will specify uncertainty to be less than the tolerances only. [vi] Comments received to update this publication. Updates are pending work of national working group analysis and efforts related to metering and meter calibrations. [vii] Updates expected to correct tolerance tables for correct rounding formatting.	

Internal Processes and Strategic Assessments

Each OWM Laboratory Metrology Program area has documented internal processes that are followed to ensure consistency on an ongoing basis. At a high level, OWM conducts annual strategic planning and selects specific strategic and operational objectives. The Laboratory Metrology Program conducts an annual SWOT analysis (identifying strengths, weaknesses, threats, and opportunities) within each program area. This method has also been used to gather input from metrologists at the annual RMAP training sessions to ensure customer input is considered and that program efforts are responsive to current and emerging national needs.

Measuring Results

As noted throughout this section, specific concepts are used to measure results in each Laboratory Metrology Program area. At one time, most of the measures were output measures. These included a count of how many laboratories were recognized, how many students attended training and how many courses were held, how many proficiency tests were conducted and in what measurement areas, along with the status of how many 105-series handbooks were published or in the process of being updated. Gradually, these measures have moved to include outcome measures where improvements are tracked, especially quality and impact. For example, the maps show how many laboratories are recognized by OWM and accredited by NVLAP. In addition, the scoring model shows the big picture assessment of all the laboratories against standardized criteria to track whether improvements (or declines) are seen from year to year in the overall national quality of the laboratories. In the training area, OWM obtained IACET Accreditation in 2013, updated in 2018, and includes formal Kirkpatrick-type course evaluations to assess satisfaction with a training experience, learning, application, and impact. In the proficiency testing area, pass-fail statistics are tracked as well as a periodic evaluation of the resulting follow-up corrective actions made by the laboratories. In the documentary standards area, the level of application and adoption within the weights and measures programs is considered.

If you have questions or comments about any of these program areas or the OWM Laboratory Metrology Program, please feel free to contact Micheal Hicks (micheal.hicks@nist.gov) or Isabel Chavez Baucom (isabel.chavez.baucom@nist.gov).

Participants

The SLP is comprised of 55 metrology laboratories. There are 50 state laboratories and 5 other government laboratories (Puerto Rico, Washington DC, Los Angeles County, USDA-GIPSA –identified as 'DA' in the survey–, and U.S.-Virgin Islands). Of these 55 laboratories, 8 are not operational. Washington DC, Delaware, Iowa, North Dakota, New Hampshire, Puerto Rico, Rhode Island, and U.S.-Virgin Islands metrology laboratories were closed during the reporting period for this survey.

Notes and Comments:

- 44 metrology laboratories provided data.
- Table 4 provides basic information summarizing the ages and sizes of the facilities in which the SLP conducts its work. It also summarizes the number of customers typically served by each laboratory.
- Office space is the overall size of the space in the laboratory devoted to administrative work. This includes space for workstations, filing, etc. In general, this category may include all of the space devoted to the laboratory not specifically dedicated to measurement work.
- Laboratory space is that space in the laboratory devoted to measurement work. This may include space where measurements are performed, space devoted to storing measurement standards and equipment, space used for material handling, space used for shipping and receiving of customer equipment, etc.
- Customers is a count of all distinct customers who received measurement services from the laboratory regardless of the reason or application.

SLP laboratories frequently provide measurement services for a fee regardless of whether the customer is regulated or not. This new category provides a measure of the number of customers using SLP laboratory services who are not otherwise required to do so.

SLP laboratories are frequently tasked with evaluating measurement equipment used by those service agents regulated by traditional Weights and Measures programs. These service agents provide calibration and repair services for measuring equipment used in commercial applications. They generally have a legal obligation to have their measure and test equipment periodically evaluated by one of the SLP member laboratories.

	Age (Years)	Office Space (Sq. Ft.)	Lab Space (Sq. Ft.)	Customers	Non-Service Agent Customers
Average	28	664	3,213	170	51
Maximum	110	2,700	12,200	585	319

Table 4: Summary of lab space, age, and customers served. (Note: Minimum values not explicitly reported as a zero value was reported in almost all summary categories by at least one lab.)

(White Space)

Table 5: (beginning next page) Listing of the SLP laboratories including location, age[1], size, and total number of customers served as of the 2020 calendar year.

[1] Laboratory age is not indicative of laboratory condition. Many facilities have been significantly renovated in recent years.

Laboratory	Address	Contact	Website	Age (Years)	Office Space (sq. ft.)	Lab Space (sq. ft.)	Customers	Non-Service Agent Customers
State of Alaska Metrology Laboratory	12050 Industry Way Suite O #6 Anchorage, AK 99515	Phone: (907) 365-1233	dot.alaska.gov/mscve/pages/metrology.shtml	6	350	1740	54	49
Alabama Department of Agriculture	1445 Federal Dr Montgomery, AL 36107	Phone: (334) 240-3729 Fax: (334) 240-7175	www.alabama.gov	47	314	588	240	0
Arkansas State Standards Laboratory	4608 W. 61st Street Little Rock, AR 72209	Phone: (501) 570-1191	www.agriculture.arkansas.gov	54	400	1500	200	15
Arizona Dept Agriculture Weights and Measures Metrology Laboratory	4425 W Olive Ave Ste 134 Glendale, AZ 85302	Phone: (602) 771-4938 Fax: (623) 563-0440	agriculture.az.gov/	21	500	5500	211	70
California State Metrology Laboratory	6790 Florin Perkins Road, Suite 100 Sacramento, CA 95828	Phone: (916) 229-4858	www.cdfa.ca.gov/dms/programs/metrology/metrology.html	17	296	3747	121	2
Colorado Metrology Lab	300 S. Technology Ct Broomfield, CO 80021	Phone: (303) 869-9241	ag.colorado.gov/labs/metrology-laboratory	2	500	2900	182	141
Connecticut Metrology Lab	9 Windsor Avenue Windsor, CT 06095	Phone: (860) 713-6165 Fax: (860) 706-1236	portal.ct.gov/DCP	8	130	1862	21	9
Florida Metrology Laboratory	3125 Conner Blvd Lab 2 Tallahassee, FL 32399	Phone: (850) 921-1580 Fax: (850) 921-1593	www.fdacs.gov	51	620	3500	217	16
Georgia Department of Agriculture Metrology Laboratory	3150 U.S. Highway 41 South Tifton, GA 31794	Phone: (229) 386-3601 Fax: (229) 386-3365	agr.georgia.gov/weights-measures.aspx	11	0	0	40	6
USDA-AMS Master Scale	5800 W. 69th Street Chicago, USDA-GIPSA 60638	Phone: (708) 458-0655	www.ams.usda.gov/services/fgix/master-scale-progrtam	92	1200	3000	5	5
Hawaii Measurement Standards Laboratory	1851 Auiki Steet Honolulu, HI 96819	Phone: (808) 832-0682 Fax: (808) 832-0683	hdoa.hawaii.gov/qad/measurement-standards	19	443	2602	52	22
Illinois Department of Agriculture Metrology Laboratory	801 Sangamon Avenue East Springfield, IL 62702	Phone: (217) 785-8480 Fax: (217) 785-3136	.	43	1200	3220	187	32
Indiana Weights & Measures Metrology Lab	2525 N Shadeland Ave. Suite 30 Indianapolis, IN 46219	Phone: (317) 719-8577 Fax: (317) 351-2877	www.statehealth.in.gov	110	400	3600	85	43
Kansas Metrology Laboratory	2004 Research Park Circle Manhattan, KS 66502	Phone: (785) 564-7477 Fax: (785) 564-6777	agriculture.ks.gov/divisions-programs/ag-lab/metrology-lab2	1	237	3751	49	27
Kentucky Department of Agriculture	107 Corporate Dr Frankfort, KY 40601	Phone: (502) 573-0282 Fax: (502) 573-0303	www.kyagr.com	20	40	2395	38	4
Louisiana Metrology Laboratory	5825 Florida Blvd Baton, LA 70806	Phone: (225) 922-1380	ldaf.state.la.us/consumers/metrology-lab/	30	432	1568	143	98

Laboratory	Address	Contact	Website	Age (Years)	Office Space (sq. ft.)	Lab Space (sq. ft.)	Customers	Non-Service Agent Customers
Massachusetts Division of Standards Metrology Laboratory	661 (Rear) Highland Avenue Needfham Heights, MA 02494	Phone: (781) 444-0219 Fax: (781) 444-0891	www.mass.gov/standards	9	160	2192	75	6
Md Dept of Agriculture, Weights & Measures Laboratory	50 Harry S Truman Pkwy Annapolis, MD 20850	Phone: (410) 841-5790 Fax: (410) 841-2765	www.mda.maryland.gov	30	930	4870	10	0
Maine Metrology Laboratory	333 Cony Rd Augusta, ME 04330	Phone: (207) 287-7587	www.maine.gov/dacf/qar/laboratory_testing/metrology.shtml	55	432	2600	143	0
State of Michigan	940 Venture Lane Williamston, MI 48895	Phone: (517) 655-8202 Fax: (517) 655-8303	www.michigan.gov/wminfo	24	2000	12200	167	82
State of MN Metrology Lab	14305 South Cross Drive W Suite 150 Burnsville, MN 55306	Phone: (651) 539-1567 Fax: (952) 435-4040	mn.gov/commerce/industries/scales-meters/metrology-lab.jsp	14	1120	4706	175	79
Missouri Metrology Laboratory	1616 Missouri Blvd Jefferson City, MO 65109	Phone: (573) 751-3440 Fax: (573) 751-0281	agriculture.mo.gov	29	385	2433	576	42
Bureau of Weights and Measures	2801 North Cooke Street Helena, MT 59601	Phone: (406) 449-2582 Fax: (406) 443-8163	bsd.dli.mt.gov/weights-and-measures	10	1200	1000	80	18
NCDA&CS Standards Laboratory	1050 Mail Service Center Raleigh, NC 27699	Phone: (919) 733-4411 Fax: (919) 733-8804	ncstandards.org	35	2700	4800	427	8
Nebraska Standards Laboratory	3721 West Cuming St. Lincoln, NE 68524	Phone: (402) 471-2087	NDA.nebraska.gov	42	580	1800	139	49
State of NJ, Office of Weights and Measures	1261 Routes 1 & 9 South Avenel, NJ 07001	Phone: (732) 815-7821 Fax: (732) 382-5298	njconsumeraffairs.gov/OWM	31	200	2700	343	319
New Mexico Department of Agriculture Metrololgy Lab	3190 S. Espina Las Cruces, NM 88003	Phone: (575) 646-1551 Fax: (575) 646-2361	nmda.nmsu.edu	48	136	2335	341	212
Nevada Metrology Lab	2150 Frazer Ave. Sparks, NV 86431	Phone: (775) 353-3788 Fax: (775) 353-3798	agri.nv.gov/Protection/Weights_and_Measures/Metrology_Lab/	47	170	1044	70	34
New York State Metrology Laboratory	10B Airline Drive Albany, NY 12235	Phone: (518) 457-4781 Fax: (518) 457-2552	www.agriculture.ny.gov/	10	975	4240	92	39
Ohio	8995 E Main St, Bldg 5 Reynoldsburg, OH 43068	Phone: (614) 728-6290	agri.ohio.gov/wps/portal/gov/oda/divisions/weights-and-measures	53	2500	3047	413	68
Oklahoma Bureau of Standards	2800 N. Lincoln Blvd. Oklahoma City, OK 73105	Phone: (405) 522-5459 Fax: (405) 522-5457	ag.ok.gov/lab/bos.htm	12	400	5807	210	142

Laboratory	Address	Contact	Website	Age (Years)	Office Space (sq. ft.)	Lab Space (sq. ft.)	Customers	Non-Service Agent Customers
Oregon Department of Agriculture	635 Capitol St NE, Ste 100 Salem, OR 97301	Phone: (503) 986-4669 Fax: (503) 986-4784	www.oregon.gov/oda/programs/MarketAccess/Pages/Metrology.aspx	22	367	2038	98	42
Pennsylvania Standards Laboratory	2221 Forster Street, Room G-44A Harrisburg, PA 17125	Phone: (717) 787-4707 Fax: (717) 705-0882	www.dgs.pa.gov	23	1568	3780	585	225
SC Department of Agriculture Metrology Laboratory	129 Ballard Court West Columbia, SC 29172	Phone: (803) 253-4052	agriculture.sc.gov/divisions/consumer-protection/metrology	3	835	8000	230	0
South Dakota Metrology Laboratory	1500 Garfield Ave Pierre, SD 57501	Phone: (605) 280-4572	dps.sd.gov/inspections/weights-measures/metrology-lab	44	0	525	104	34
Julius Johnson Metrology Lab	(615) 837-5159 Nashville, TN 37211	Phone: (615) 253-4426	www.tn.gov/agriculture/consumers/standards/metrology.html	3	2000	6000	53	0
Texas Department of Agriculture Giddings Metrology Lab	PO Box 1518, 1258 CR 226 Giddings, TX 78942	Phone: (979) 542-3231	www.texasagriculture.gov/RegulatoryPrograms/WeightsandMeasures/MetrologyLab.aspx	18	1200	11077	146	0
State of Utah Metrology Lab	350 North Redwood Rd Salt Lake City, UT 84116	Phone: (801) 982-2267 Fax: (385) 465-6023	ag.utah.gov	35	150	1350	60	42
VDACS	600 North 5th street Richmond, VA 23219	Phone: (804) 786-0479		0	0	0	169	59
Vermont State Metrology Laboratory	163 Admin Drive Randolph Center, VT 05061	Phone: (802) 522-5415	agriculture.vermont.gov	2	500	1500	108	48
WA St. Dept. of Agriculture Metrology Laboratory	PO Box 42560 Olympia, WA 98504	Phone: (360) 753-5042 Fax: (360) 586-4728	agr.wa.gov/departments/laboratories/metrology-lab	43	230	2734	289	100
Wisconsin Weights and Measures Laboratory	3601 Galleon Run Madison, WI 53718	Phone: (608) 224-4913 Fax: (608) 224-4912	datcp.wi.gov/Pages/Programs_Services/MetrologyLab.aspx	14	550	3700	325	25
WV Weights and Measures	570 MacCorkle Avenue St. Albans, WV 25177	Phone: (304) 722-0602 Fax: (304) 722-0605	www.labor.wv.gov	50	231	1769	166	39
Wyoming Department of Agriculture	6607 Campstool Rd Cheyenne, WY 82009	Phone: (307) 777-7556 Fax: (307) 777-1943	agriculture.wy.gov	9	650	1660	50	12

Laboratory Survey Participation

Survey Participation Matrix															
Lab Code/Year	1996	1998	1999	2000	2002	2004	2005	2006	2008	2010	2012	2014	2016	2018	2020
AK	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AL	Yes				Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AR	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AZ	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CA	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CO	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CT	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
DE	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)
FL	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
GA	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
HI	Yes	Yes	Yes	(inactive)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
IA	Yes	Yes	Yes		(inactive)	Yes	Yes	Yes	Yes	Yes	Yes	(inactive)	(inactive)	(inactive)	(inactive)
ID	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
IL	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
IN	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes
KS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
KY	Yes	Yes	Yes	Yes	Yes	(inactive)	(inactive)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
LA	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MA	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes
MD	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ME	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MI	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MN	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MO	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MS	Yes	Yes		(inactive)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
MT	Yes	Yes	Yes	Yes	Yes	Yes			Yes	Yes		Yes	Yes	Yes	Yes
NC	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ND	Yes	Yes	Yes	Yes	Yes	(inactive)	Yes	Yes	Yes		(inactive)	(inactive)	(inactive)	(inactive)	(inactive)

Lab Code/Year	1996	1998	1999	2000	2002	2004	2005	2006	2008	2010	2012	2014	2016	2018	2020
NE	Yes	Yes			Yes	Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes
NH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	(inactive)
NJ	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NM	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NV	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NY	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OK	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OR	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
PA	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
RI	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)
SC	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SD	Yes	Yes			(inactive)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TN	Yes	Yes	Yes	Yes	Yes	(inactive)	Yes	Yes	Yes		Yes	Yes	Yes	No	Yes
TX	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
UT	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
VA	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
VT	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WA	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WI	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WV	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
WY	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
USDA-GIPSA	Yes					Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Wash. DC	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)
Virgin Islands	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)	(inactive)
Puerto Rico	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	(inactive)
LA County	Yes	Yes	Yes	Yes	Yes	(inactive)	(inactive)	(inactive)	Yes	Yes	Yes	Yes	Yes	Yes	No
TOTAL	51	46	45	44	48	47	46	49	50	47	48	49	49	45	47

Table 6: Listing of SLP member laboratories and their participation status in previous surveys (blanks indicate non-participation).

Grand Total

In order to give a very high-level overview of the measurement work performed by the SLP program the survey team added the number of measurements reported by all of the laboratories for each measurement procedure surveyed to come up with a grand total. This total does not factor in time or effort required in performing individual measurements. The reader is referred to the supplementary section of the 2014 edition of the SLP Workload Survey for data on the time required to complete individual measurements.

Survey	Labs	Total Devices	Lab Average
1996	51	322,472	6,323
1998	46	320,931	6,977
1999	45	352,274	7,828
2000	45	361,600	8,036
2002	48	375,411	7,821
2004	47	355,986	7,574
2005	46	361,054	7,849
2006	49	365,004	7,449
2008	50	367,336	7,347
2010	47	368,333	7,837
2012	47	305,728[2]	6,505
2014	49	336,858	6,875
2016	49	400,911[3]	8,182
2018	45	326,219[4]	7,244
2020	44	306,860[5]	7,064

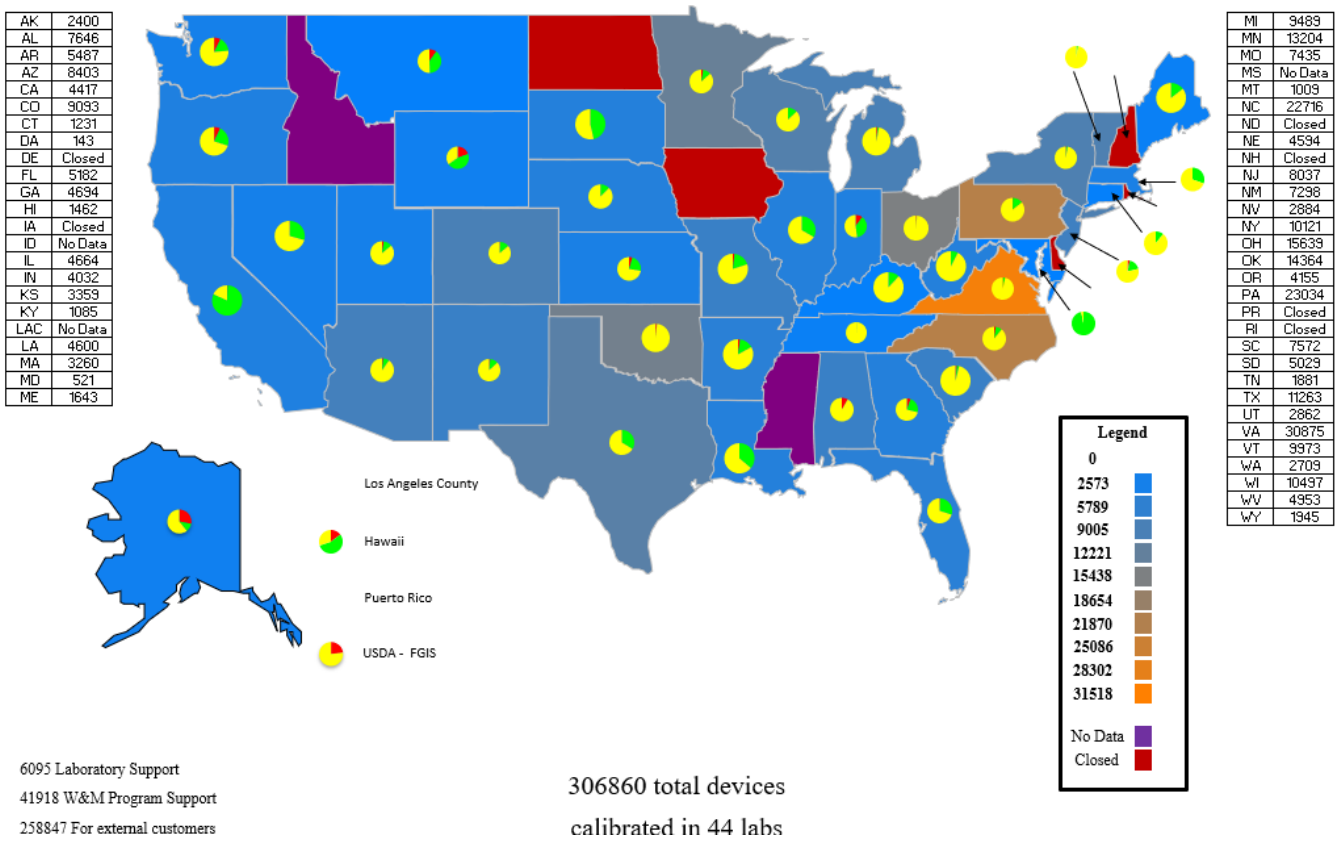
Table 7: Summary of all measurements reported on prior surveys.

[2] The dip in SLP measurement production reported in 2012 is attributed in large part to the absence of a survey response from Puerto Rico. Puerto Rico routinely reports testing approximately 30,000 lottery balls

[3] In 2016 the metrology laboratory in Puerto Rico reported testing 69,800 lottery balls. This number is a little over double what has been historically reported by this laboratory. This accounts for a large portion of the increase in measurement production reported by the SLP this year.

[4] The dip in SLP measurement production reported in 2018 is attributed in large part to the absence of a survey response from Puerto Rico. Puerto Rico routinely reports testing approximately 30,000 lottery balls

[5] In 2020 COVID-19 and the associated efforts to control the impact of the disease on hospitals nationwide significantly affected the U.S. economy.



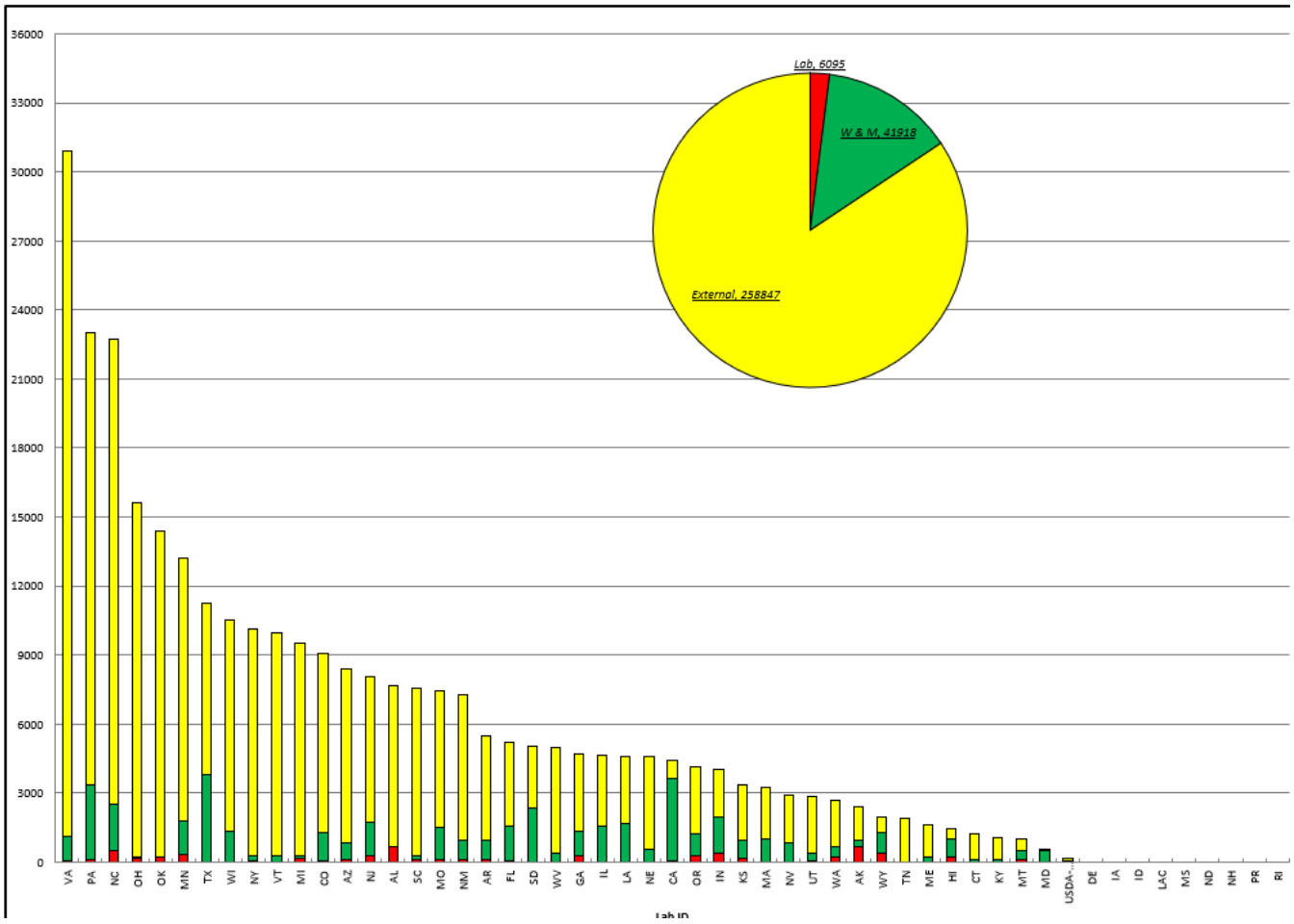


Figure 2: Total of all measurements reported.

Mass

Mass weighing procedures are broken into several categories based on measurement procedures and the category of mass standard measured for the purpose of this report.

Echelon I weighing procedures are those mass calibrations which use calibration designs, such as those detailed in the NIST SEMATECH Engineering Statistics Handbook and NIST Technical Note 952, that are solved using numerical least squares approximations, and correct for air buoyancy when inter-comparing weights of unequal volume. These calibrations are typically associated with, but are not limited to high precision weight standards such as those specified in ASTM E617 Class 0 or OIML E1. Masscode is the industry standard software used to analyze data collected for an echelon I calibration. Any calibration for which a laboratory used Masscode to analyze the primary data is considered to be an echelon I calibration for this survey.

Echelon II weighing procedures are typically used when high tolerance class calibrations are requested. These typically involve many redundant measurements in order to reduce the overall measurement uncertainty to an acceptable level. Unlike Echelon I, conventional mass corrections of the laboratory standards are typically used in lieu of performing air buoyancy corrections. Examples of echelon II mass calibration procedures may be found in NIST Internal Report 6969 (Harris, NIST IR 6969, "Selected Laboratory and Measurement Practices, and Procedures, to Support Basic Mass Calibrations", 2014), SOP 4 and SOP 7 (Harris, NIST IR 6969, "Selected Laboratory and Measurement Practices, and Procedures, to Support Basic Mass Calibrations", 2014).

Echelon III weighing procedures are essentially everything else with the exception of measurements performed on weight carts, railroad test cars, and railroad specific weight carts. A typical echelon III procedure is SOP 8 found in NIST Internal Report 6969 (Harris, NIST IR 6969, "Selected Laboratory and Measurement Practices, and Procedures, to Support Basic Mass Calibrations", 2014). Most mass standards tested in SLP metrology lab fall into this category (91%)[6]

Weight Carts are motorized carts used to transport a load of field test weights to facilitate the field testing of larger capacity scales. Weight carts are often subject to the specifications and tolerances found in NIST Handbook 105-8 (NIST Handbook 105-8 "Specifications and Tolerances for Field Standard Weight Carts", 2019) are typically tested using echelon III procedures. They are, never the less, treated separately herein as they are distinct from field test weights.

Railroad Test Cars are certified mass standards built for AAR interchange service used to facilitate the testing of railroad track scales. Specifications for these field standards are published by The Association of American Railroads (AAR Scale Handbook 2013 Edition, 2013). Certification of these mass standards is typically done using a master scale facility certified by the USDA Grain Inspection, Packers and Stockyard Association (GIPSA).

Railroad Specific Weight Carts are certified mass standards used to facilitate testing of railroad track scales. Unlike railroad test cars these devices by themselves are not suitable for AAR

[6] by count of mass standards tested only. The time required to complete a test is outside the scope of this survey.

interchange service. Unlike traditional weight carts these devices are designed transport 80,000 lb or more of test weight short distances on rail. Certification of these mass standards is typically done using a master scale facility certified by the USDA Grain Inspection, Packers and Stockyard Association (GIPSA) as these carts can weigh 10,000 lb or more. Additional weights loaded onto the cart are standard cast iron field test weights and are covered under Echelon III weighing procedures.

Mass Echelon I

Description

The graphs on the following page represent the total number of Mass Echelon I standards evaluated by the 44 reporting laboratories. The map graph illustrates a geographical distribution of the measurements. There are pie graphs located on the map for each individual lab and a larger pie graph that reflects the totals. The pie graphs provide a breakdown into the customer categories of Lab, W&M, and External. The bar graph at the bottom of the page shows the same breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

Of the 44 reporting laboratories, 9 labs tested a total of 2,686 mass standards

Comparison of previous surveys

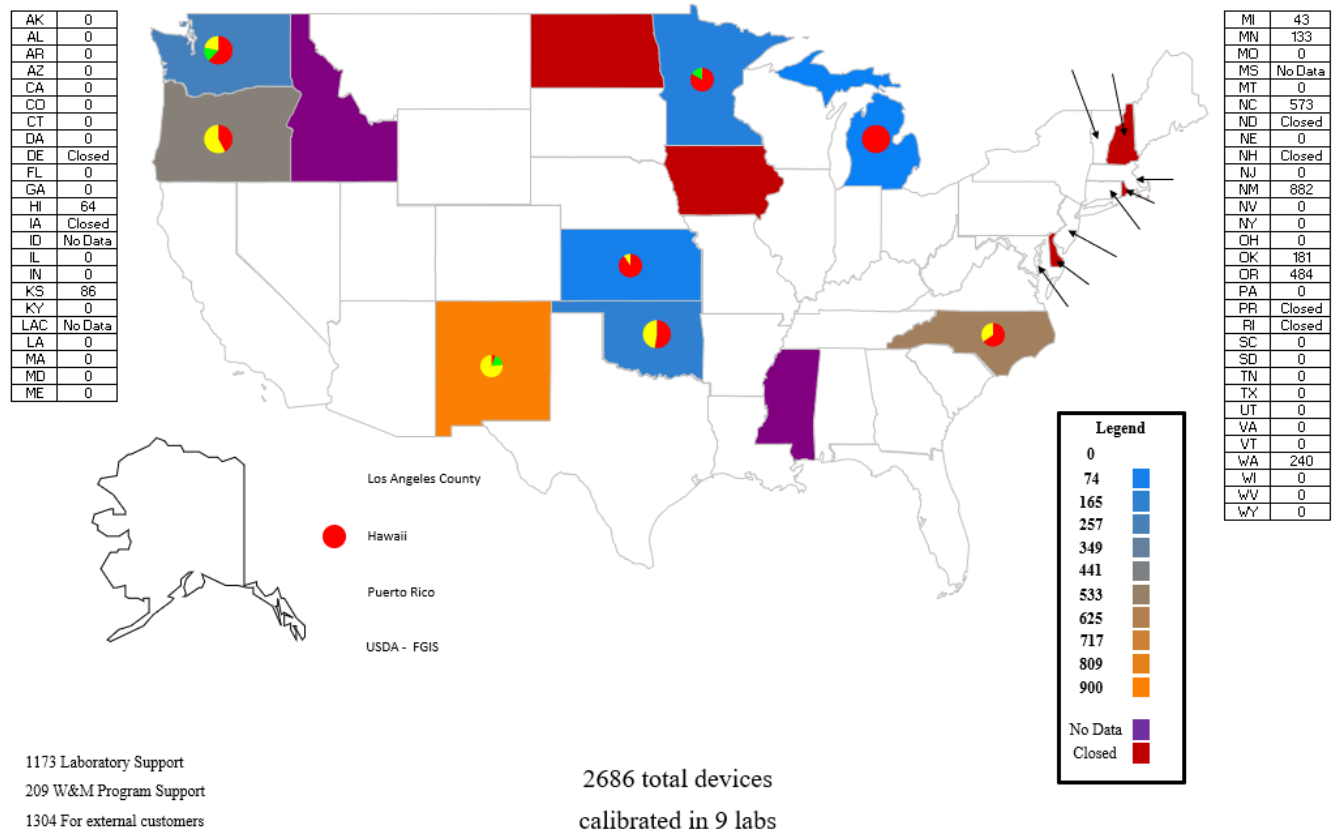
Year	# Labs	Total Devices
1998	10	2,667
1999	15	5,985
2000	16	5,227
2002	15	5,288
2004	14	3,707
2005	14	3,103
2006	14	3,025
2008	17	2,216
2010	19	2,309
2012	12	2,493
2014	13	2,980
2016	11	1,845
2018	11	2,485
2020	9	2,686

Table 8: Summary of echelon I tests reported on previous surveys.

Results for Mass I cannot be compared to the 1996 survey as it did not use Mass Echelon I as a category. ‘Precision Mass’ was used as the category and it included both Mass Echelon I and Mass Echelon II calibrations.

Notes and Comments

- 44 % of all Mass I standards were calibrated for internal use by the laboratory.
- 8 % of all Mass I standards were calibrated for the weight and measures program.
- 49 % of all Mass I standards were calibrated for external customers.



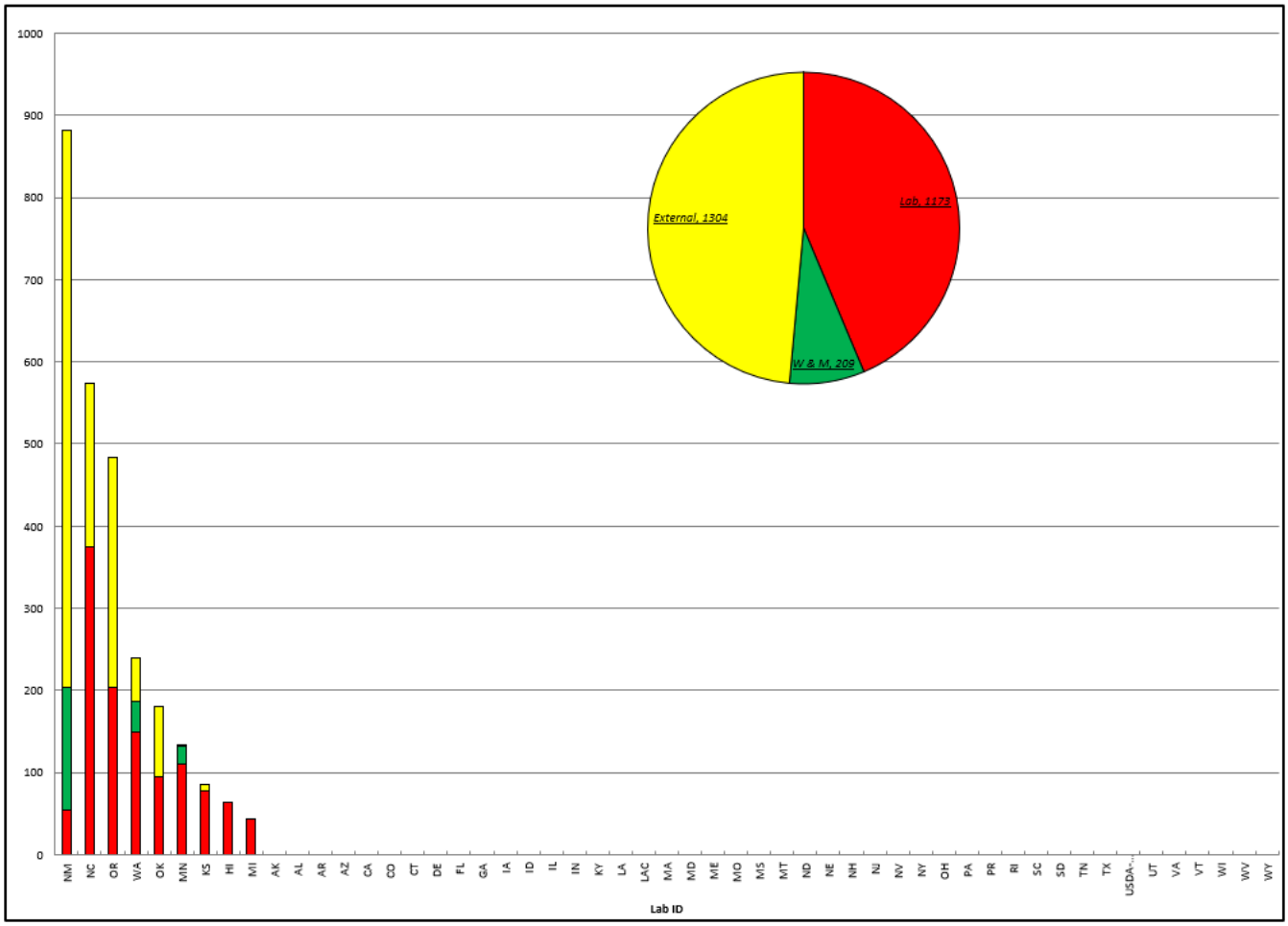


Figure 3: Mass Echelon I tests.

Mass Echelon II

Description

The graphs on the following page represent the total number of Mass Echelon II standards evaluated by the 44 reporting laboratories. The map graph illustrates a geographical distribution of the measurements. There are pie graphs located on the map for each individual lab and a larger pie graph that reflects the totals. The pie graphs provide a breakdown into the customer categories of Lab, W&M, and External. The bar graph at the bottom of the page shows the same breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

Of the 44 reporting laboratories, 26 labs tested a total of 12,083 mass standards

Comparison of previous surveys

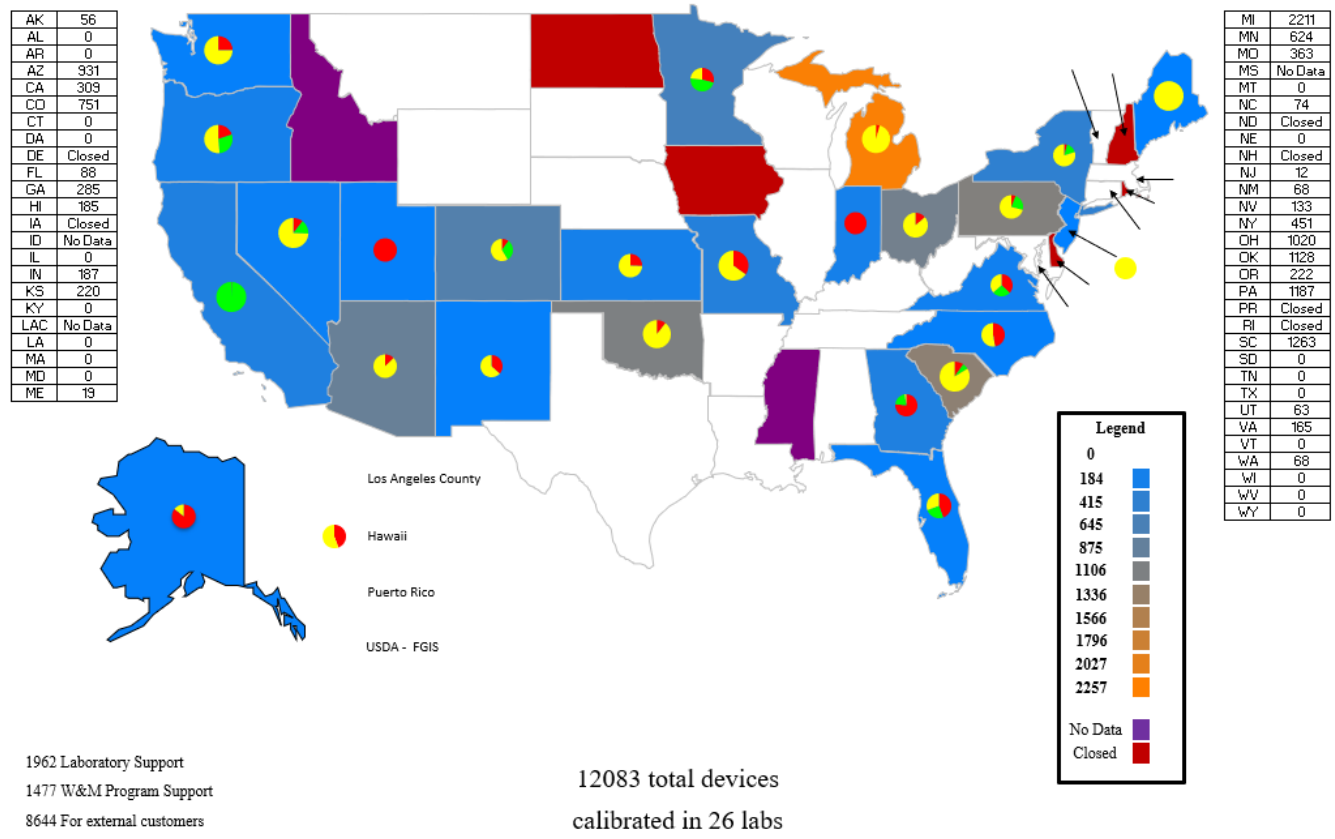
Year	# Labs	Total Devices
1996	38	37,662
1998	36	24,926
1999	35	25,807
2000	38	26,428
2002	37	25,847
2004	32	21,714
2005	32	20,541
2006	33	22,352
2008	32	25,371
2010	34	23,316
2012	30	18,222
2014	26	16,832
2016	27	11,723
2018	27	14,456
2020	26	12,083

Table 9: Echelon II tests reported on previous surveys.

Results for Mass II cannot be compared to the 1996 survey as it did not use Mass Echelon II as a category. ‘Precision Mass’ was used as the category and it included both Mass Echelon I and Mass Echelon II calibrations.

Notes and Comments

- 16 % of all Mass II standards were calibrated for internal use by the laboratory.
- 12 % of all Mass II standards were calibrated for the weight and measures program.
- 72 % of all Mass II standards were calibrated for external customers.



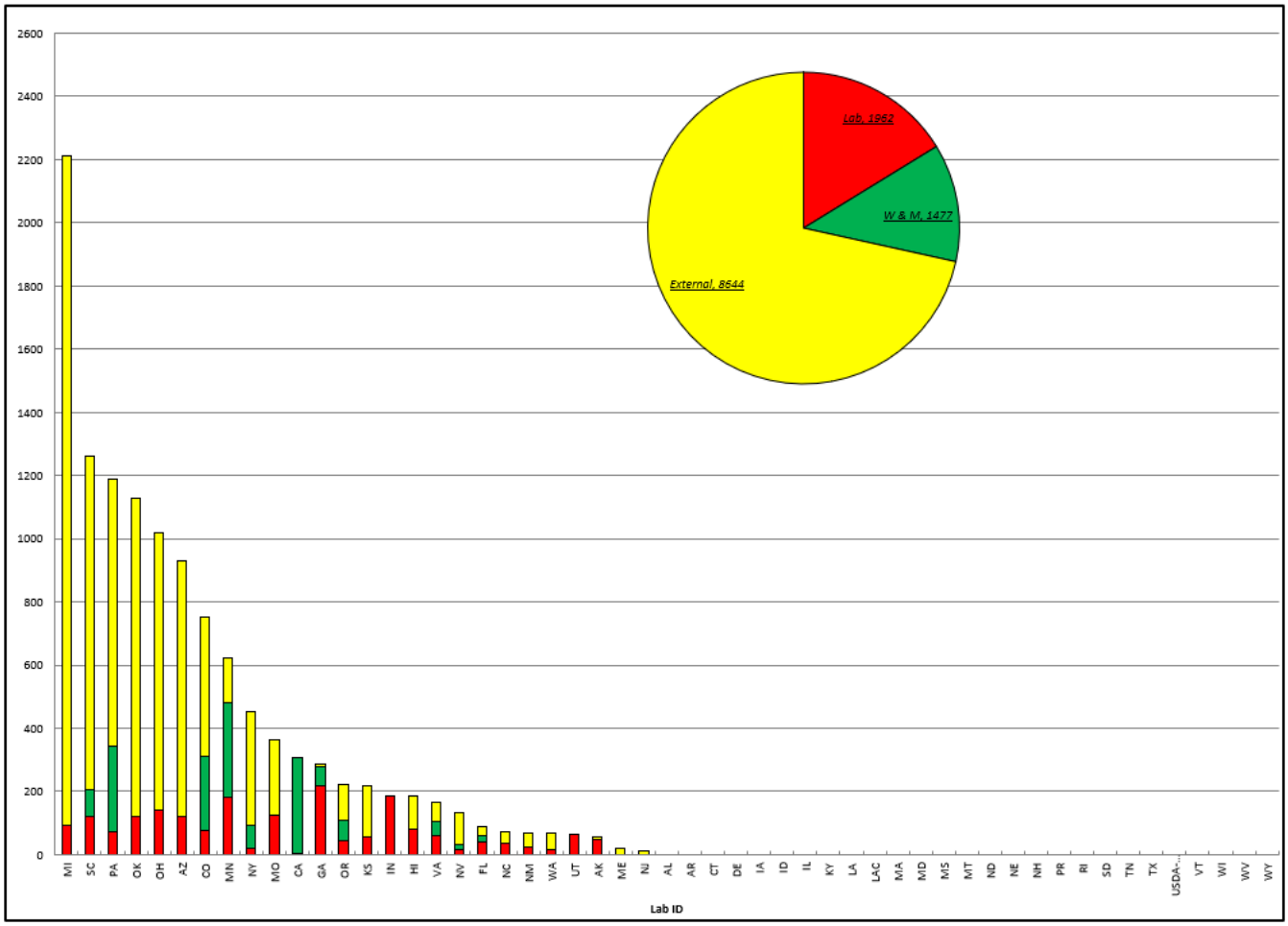


Figure 4: Mass Echelon II tests.

Mass Echelon III

Description

The graphs on the following page represent the total number of Mass Echelon III standards evaluated by the 44 reporting laboratories. The map graph illustrates a geographical distribution of the measurements. There are pie graphs located on the map for each individual lab and a larger pie graph that reflects the totals. The pie graphs provide a breakdown into the customer categories of Lab, W&M, and External. The bar graph at the bottom of the page shows the same breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

Of the 44 reporting laboratories, 44 labs tested a total of 245,846 mass standards

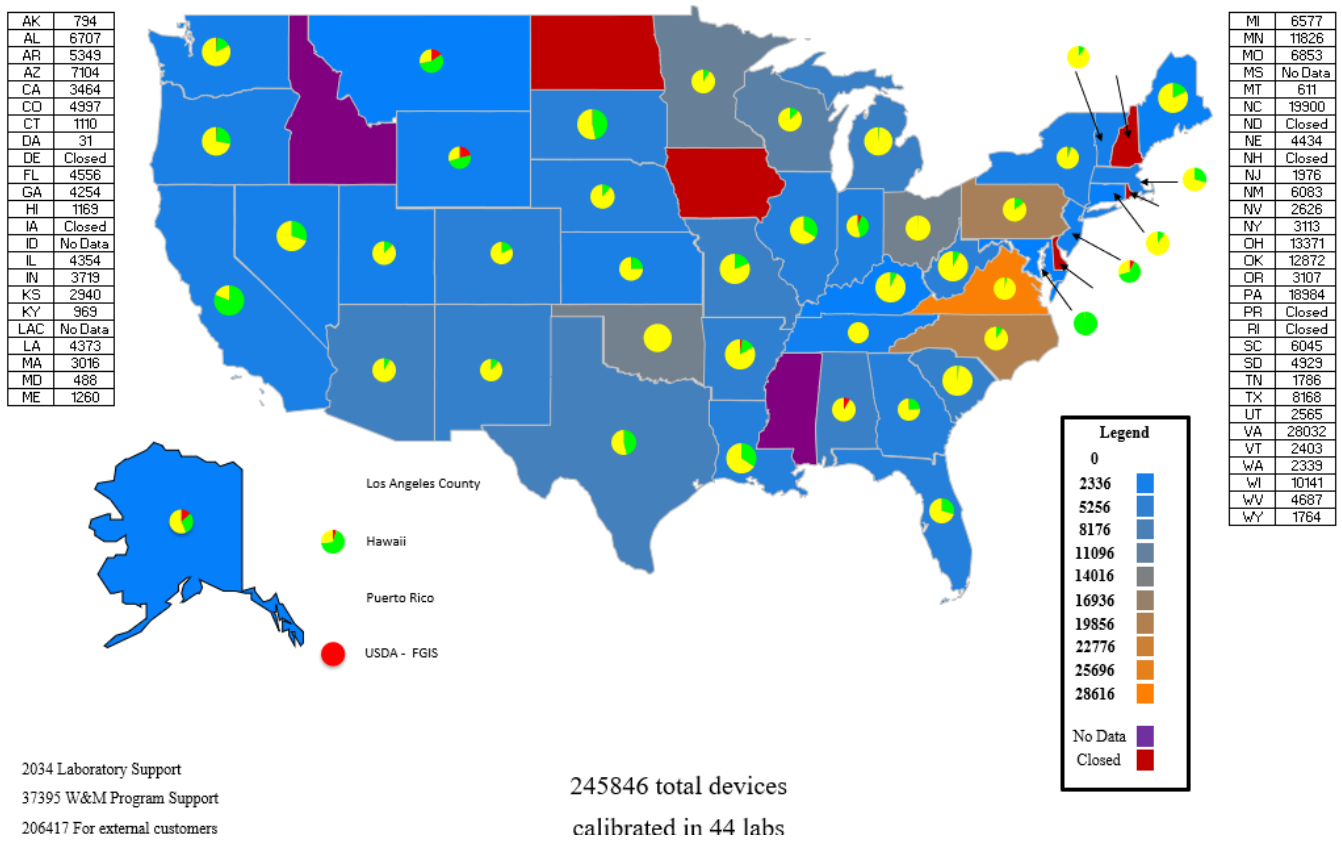
Comparison of previous surveys

Year	# Labs	Total Devices
1996	51	259,713
1998	46	259,166
1999	45	257,938
2000	45	260,072
2002	47	267,240
2004	47	248,117
2005	46	248,650
2006	49	256,844
2008	50	254,221
2010	47	256,094
2012	47	256,094
2014	47	244,985
2016	48	261,823
2018	45	258,852
2020	44	245,846

Table 10: Echelon III tests reported on previous surveys.

Notes and Comments

- 1 % of all Mass III standards were calibrated for internal use by the laboratory.
- 14 % of all Mass III standards were calibrated for the weight and measures program.
- 85 % of all Mass III standards were calibrated for external customers.



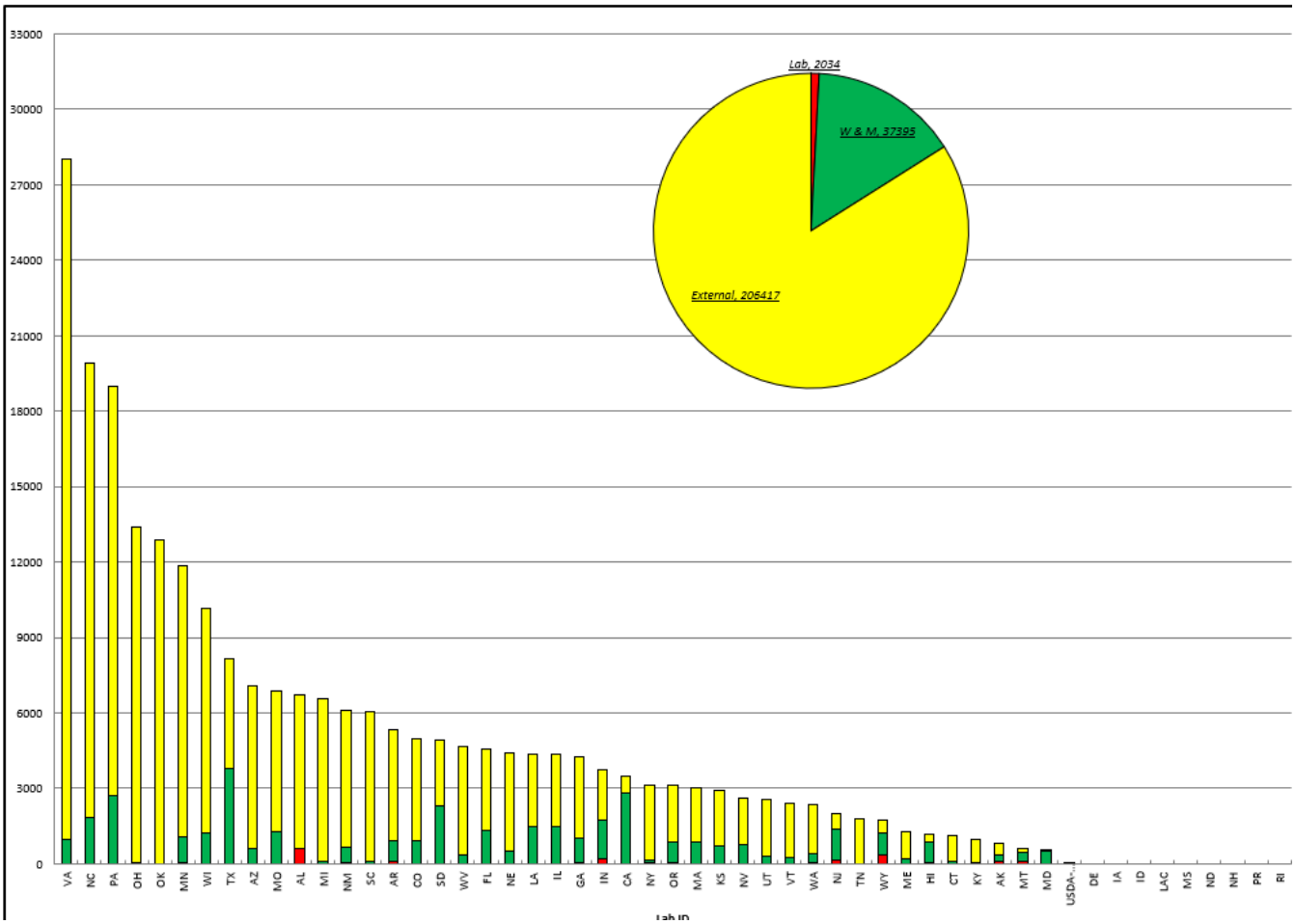


Figure 5: Mass Echelon III tests.

Weight Carts

Description

The graphs on the following page represent the total number of weight carts evaluated by the 44 reporting laboratories. The map graph illustrates a geographical distribution of the measurements. There are pie graphs located on the map for each individual lab and a larger pie graph that reflects the totals. The pie graphs provide a breakdown into the customer categories of Lab, W&M, and External. The bar graph at the bottom of the page shows the same breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

Of the 44 reporting laboratories, 29 labs tested a total of 587 weight carts

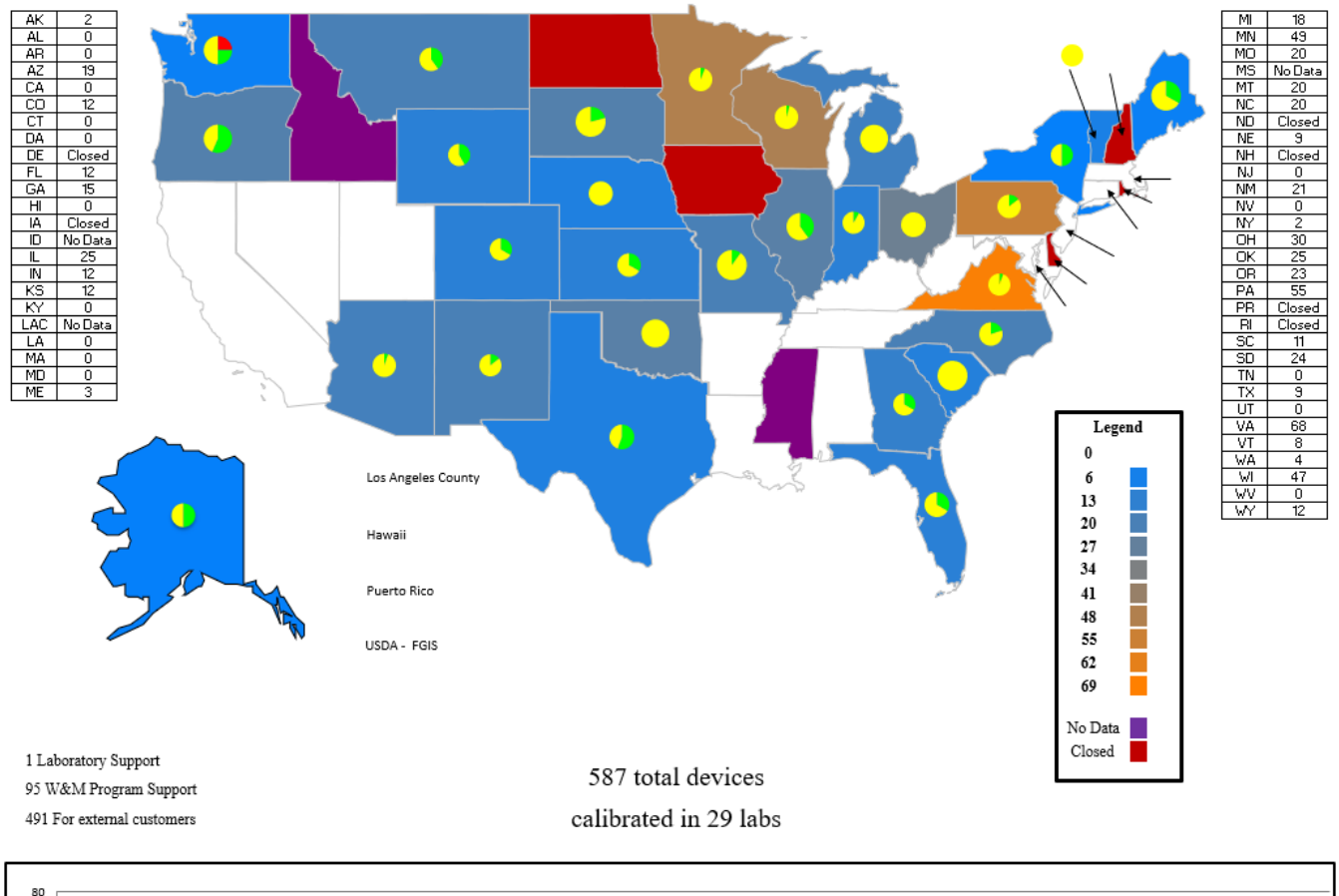
Comparison of previous surveys

Year	# Labs	Total Devices
1998	30	297
2000	27	344
2002	29	388
2004	33	365
2005	30	410
2006	31	388
2008	32	445
2010	35	468
2012	31	433
2014	30	517
2016	31	572
2018	30	585
2020	29	587

Table 11: Weight Cart tests reported on previous surveys.

Notes and Comments

- <1 % of all weight carts were calibrated for internal use by the laboratory.
- 16 % of all weight carts were calibrated for the weight and measures program.
- 84 % of all weight carts were calibrated for external customers.



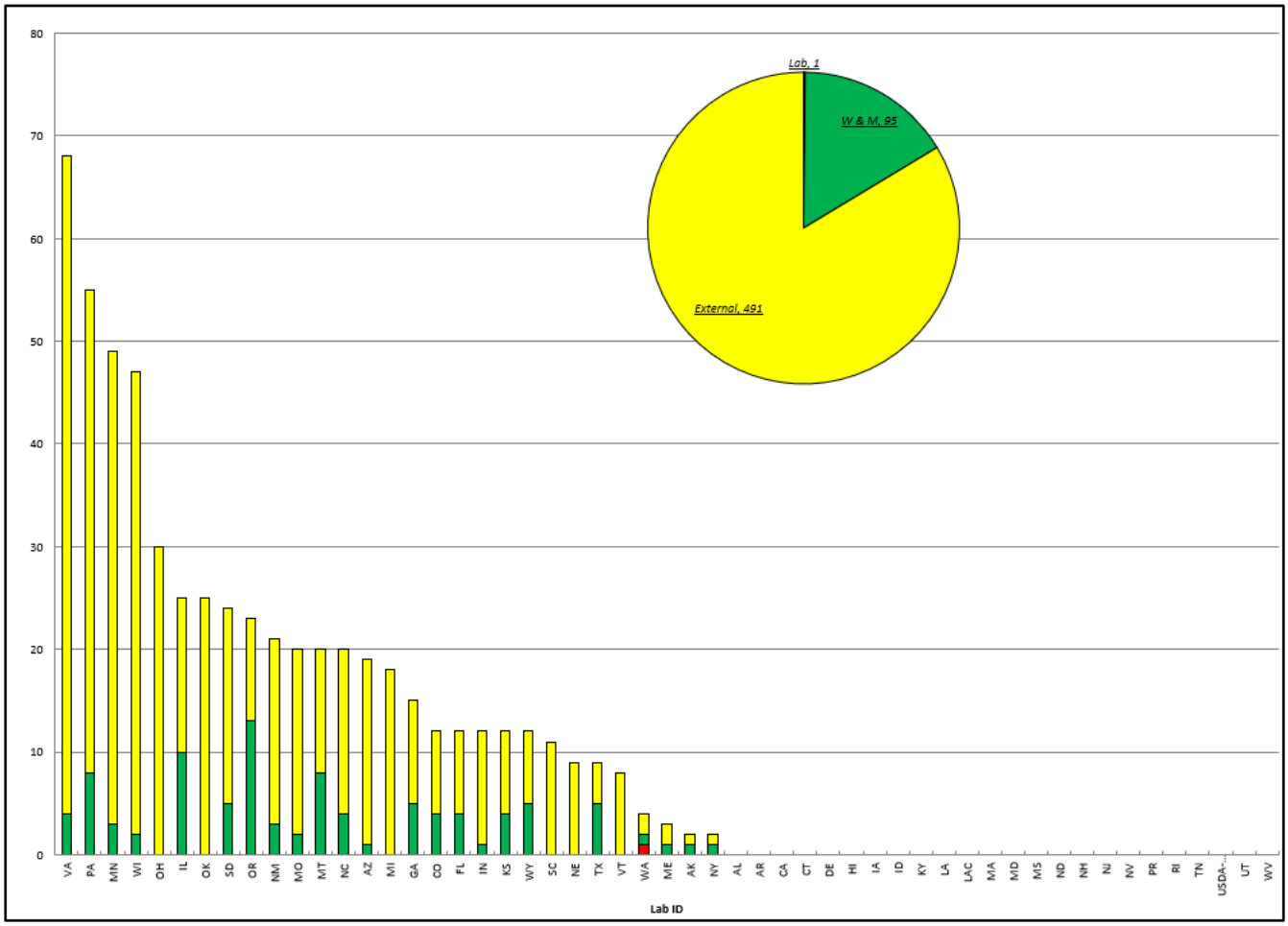


Figure 6: Weight Cart tests.

Railroad Test Cars

Description

The graphs on the following page represent the total number of railroad test cars evaluated by the 44 reporting laboratories. The map graph illustrates a geographical distribution of the measurements. There are pie graphs located on the map for each individual lab and a larger pie graph that reflects the totals. The pie graphs provide a breakdown into the customer categories of Lab, W&M, and External. The bar graph at the bottom of the page shows the same breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

Of the 44 reporting laboratories, 3 labs tested a total of 30 railroad test cars

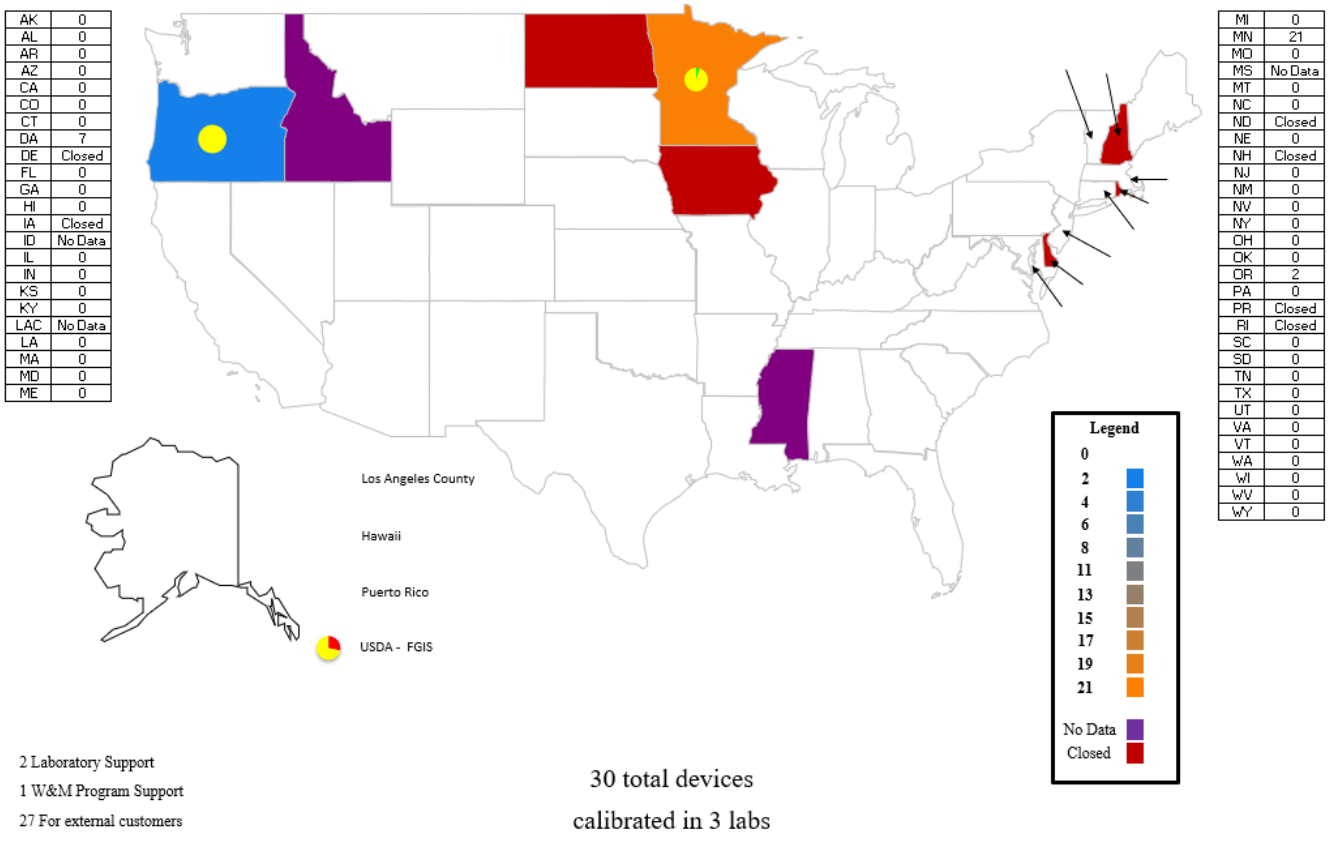
Comparison of previous surveys

Year	# Labs	Total Devices
2016	5	43
2018	3	16
2020	3	30

Table 12: Railroad Test Car tests reported on previous surveys.

Notes and Comments

- 7 % of all railroad test cars were calibrated for internal use by the laboratory.
- 3% of all railroad test cars were calibrated for the weight and measures program.
- 90 % of all railroad test cars were calibrated for external customers.



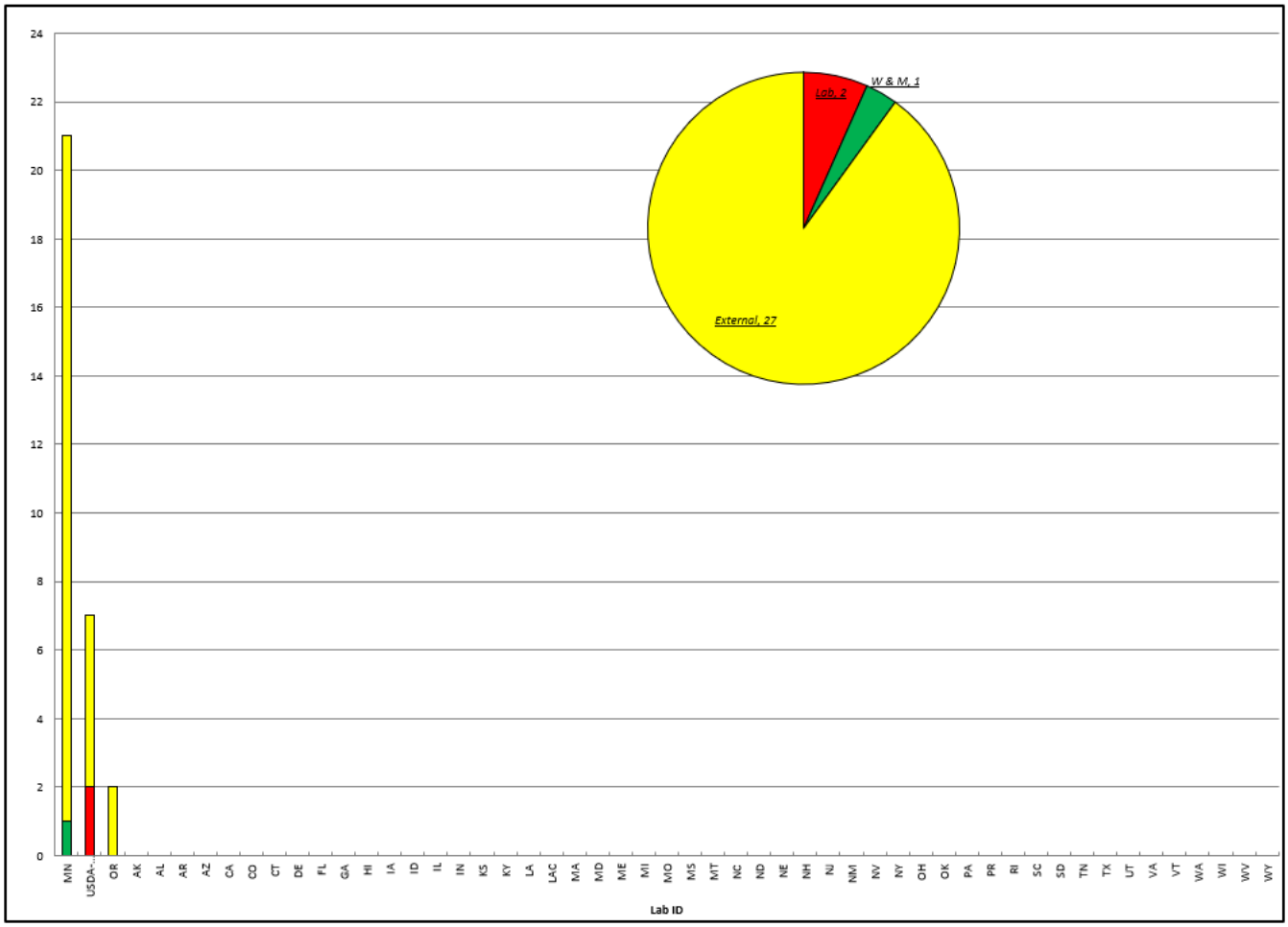


Figure 7: Railroad Test Car tests.

Railroad Specific Weight Carts

Description

The graphs on the following page represent the total number of railroad specific weight carts evaluated by the 44 reporting laboratories. The map graph illustrates a geographical distribution of the measurements. There are pie graphs located on the map for each individual lab and a larger pie graph that reflects the totals. The pie graphs provide a breakdown into the customer categories of Lab, W&M, and External. The bar graph at the bottom of the page shows the same breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

Of the 44 reporting laboratories, 3 labs tested a total of 8 railroad specific weight carts

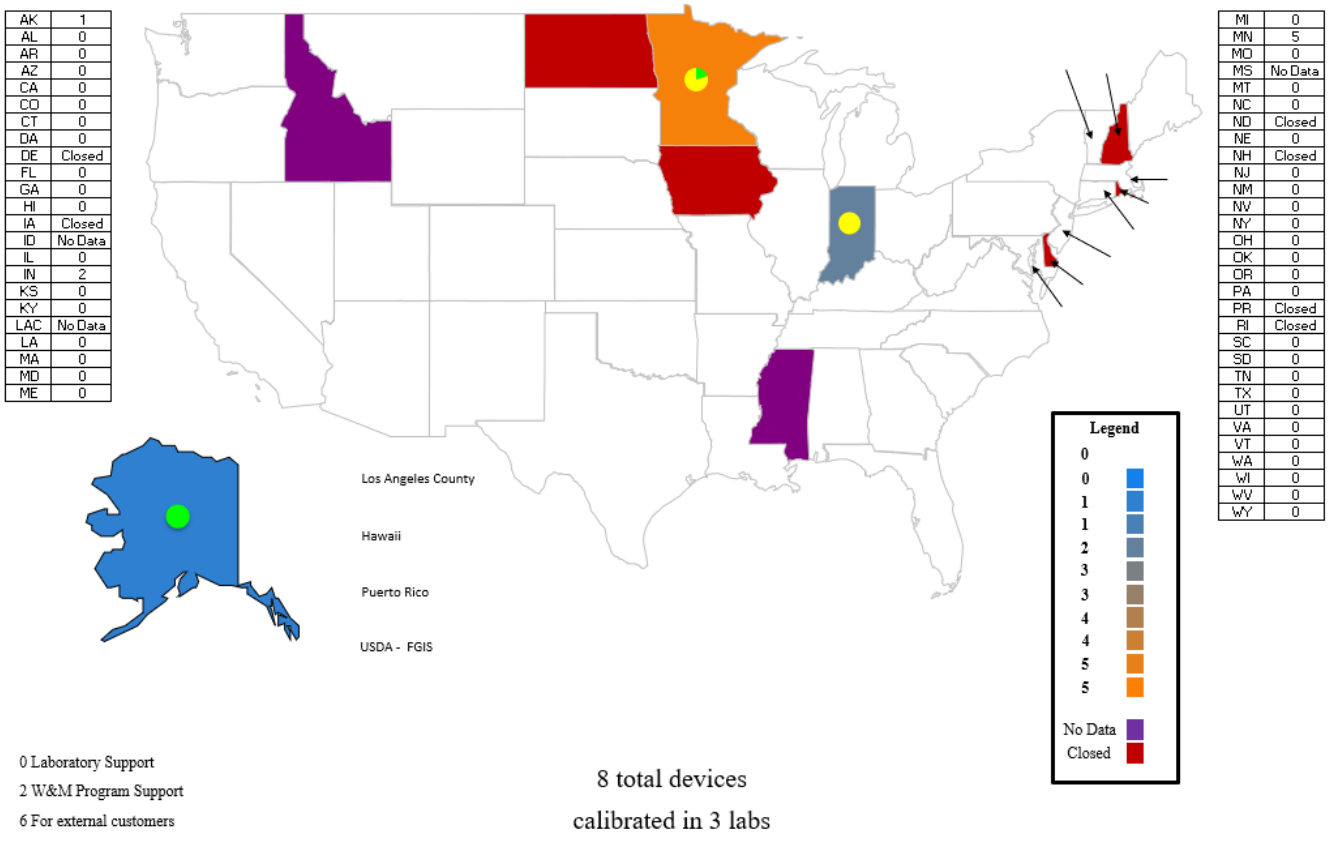
Comparison of previous surveys

Year	# Labs	Total Devices
2016	5	13
2018	7	33
2020	3	8

Table 13: Railroad Specific Weight Carts tests reported on previous surveys.

Notes and Comments

- 0 % of all weight carts were calibrated for internal use by the laboratory.
- 25 % of all weight carts were calibrated for the weight and measures program.
- 75 % of all weight carts were calibrated for external customers.



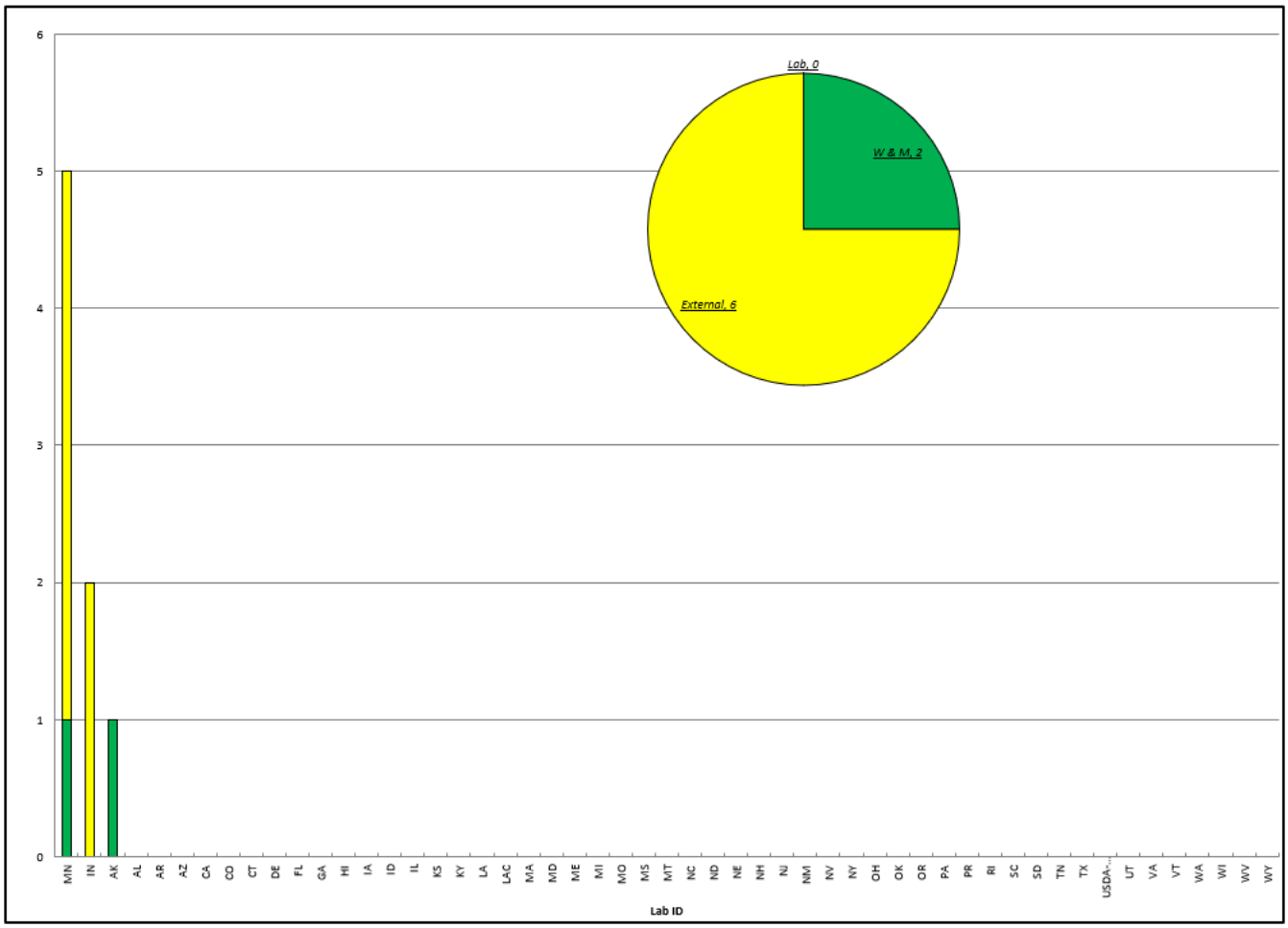


Figure 8: Railroad Specific Weight Cart tests.

Length

SLP Laboratories normally test two distinct classes of length standards, steel tape measures (surveyor's tapes or pi tapes for example) and rigid steel rules.

A typical measurement procedure for calibrating a rigid steel rule involves the side by side comparison of two rigid steel rules with the aid of a microscope. Two measurement procedures are commonly employed by the SLP laboratories to test steel tape measures. One involves the direct comparison of two flat steel tapes the other a direct comparison of a surveyor tape to a fixed length bench calibrated at 1 ft intervals out to 16 ft. Measurement procedures may be found in NISTIR 8028, 2014, *Selected Laboratory and Measurement Practices and Procedures for Length Calibrations, Jose A. Torres, Georgia L. Harris.*

Steel Tape Measures

Description

The graphs on the following page represent the total number of tape measures evaluated by the 44 reporting laboratories. The map graph illustrates a geographical distribution of the measurements. There are pie graphs located on the map for each individual lab and a larger pie graph that reflects the totals. The pie graphs provide a breakdown into the customer categories of Lab, W&M, and External. The bar graph at the bottom of the page shows the same breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

Of the 44 reporting laboratories, 5 labs tested a total of 226 tape measures

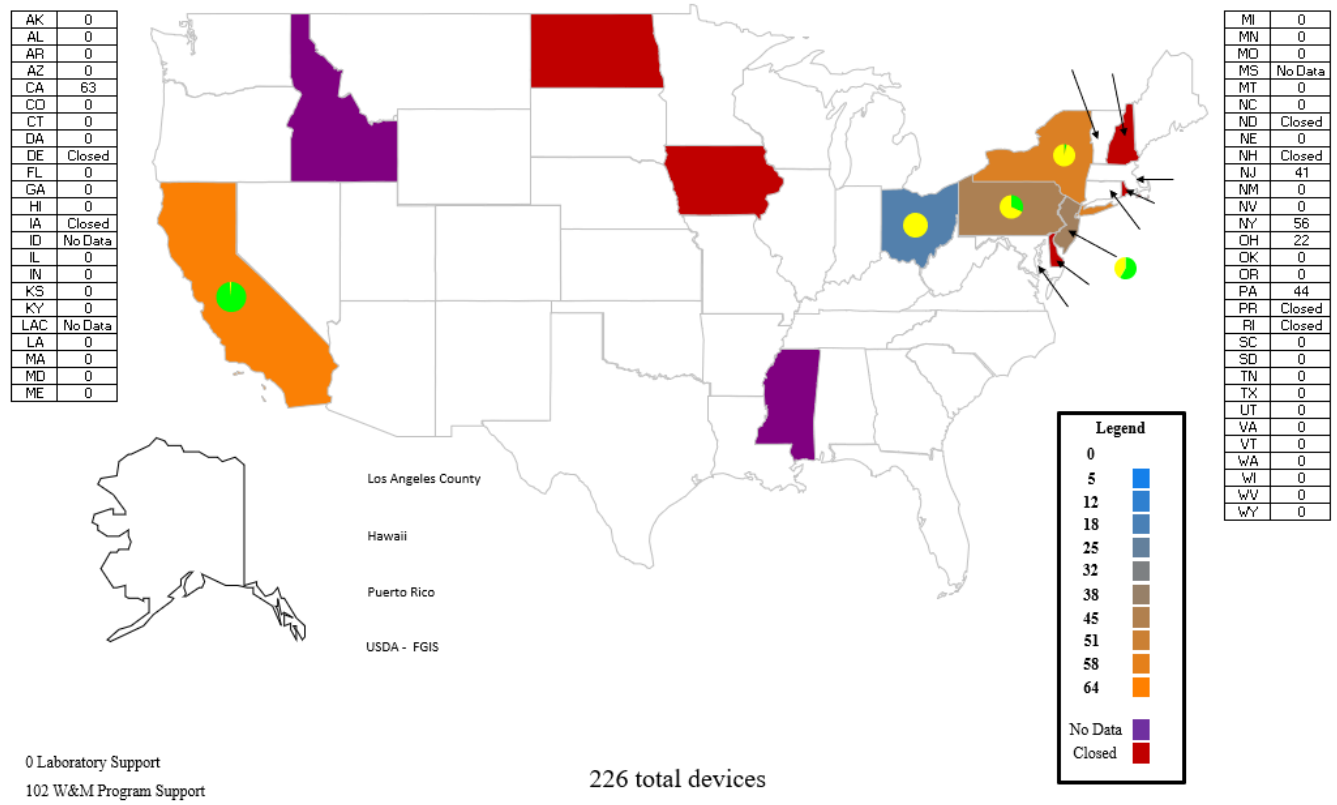
Comparison of previous surveys

Year	# Labs	Total Devices
1996	27	707
1998	29	537
1999	21	566
2000	22	487
2002	21	584
2004	21	319
2005	19	304
2006	18	339
2008	17	425
2010	15	310
2012	12	353
2014	9	323
2016	7	319
2018	5	213
2020	5	226

Table 14: Tape measure tests reported on previous surveys.

Notes and Comments

- 0 % of all tape measures were tested for internal use by the laboratory.
- 45 % of all tape measures were tested for the weight and measures program.
- 55 % of all tape measures were tested for external customers.



0 Laboratory Support
102 W&M Program Support
124 For external customers

226 total devices
calibrated in 5 labs

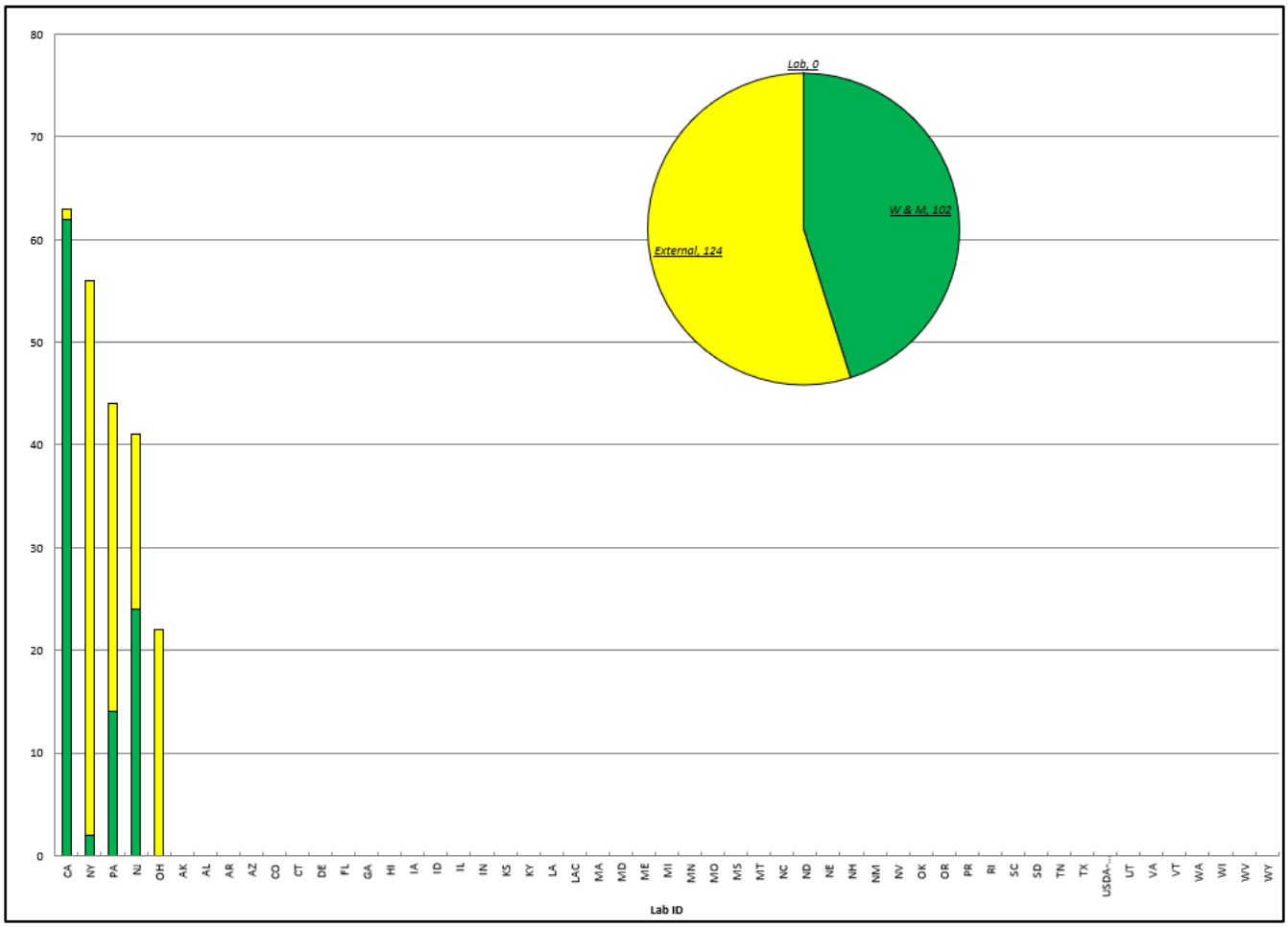


Figure 9: Tape Measure tests.

Rigid Rules

Description

The graphs on the following page represent the total number of rigid rules evaluated by the 44 reporting laboratories. The map graph illustrates a geographical distribution of the measurements. There are pie graphs located on the map for each individual lab and a larger pie graph that reflects the totals. The pie graphs provide a breakdown into the customer categories of Lab, W&M, and External. The bar graph at the bottom of the page shows the same breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

Of the 44 reporting laboratories, 3 labs tested a total of 30 rigid rules.

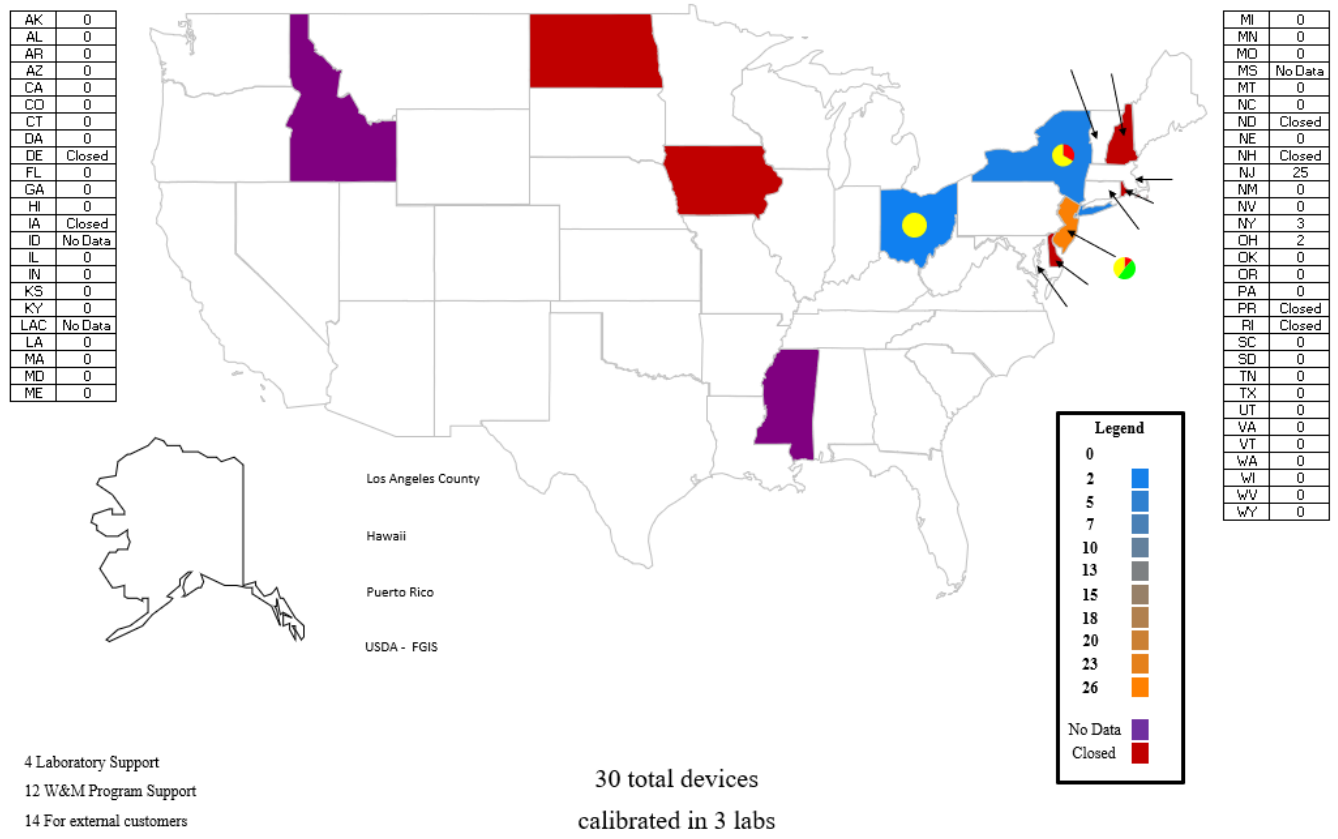
Comparison of previous surveys

Year	# Labs	Total Devices
1996	26	582
1998	29	269
1999	20	413
2000	16	169
2002	14	138
2004	12	98
2005	11	85
2006	11	122
2008	11	88
2010	8	89
2012	3	85
2014	3	54
2016	2	36
2018	4	184
2020	3	30

Table 15: Rigid rule tests reported in previous surveys.

Notes and Comments

- 13 % of all rigid rules were tested for internal use by the laboratory.
- 40 % of all rigid rules were tested for the weight and measures program.
- 47 % of all rigid rules were tested for external customers.



4 Laboratory Support
12 W&M Program Support
14 For external customers

30 total devices
calibrated in 3 labs

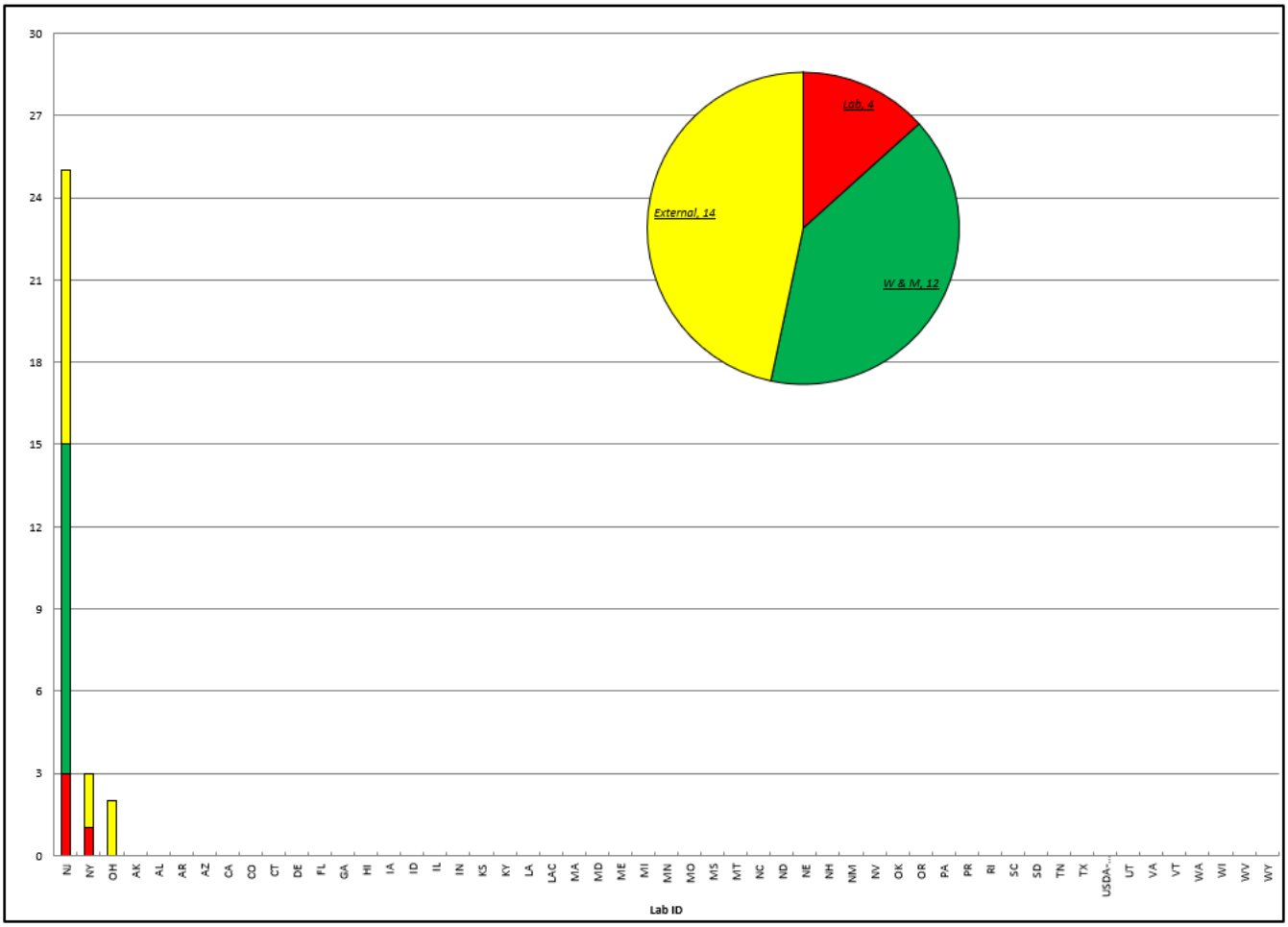


Figure 10: Rigid rule tests.

Volume

Volume measurement service are the 2nd most commonly performed by the SLP laboratories next to mass measurement. Volume measurement is broken down into distinct categories based upon the type of volumetric standard tested. The categories are glassware, volume test measures (≤ 5 gallons), medium volume provers (>5 gallons and ≤ 100 gallons), and large volume provers (> 100 gallons).

Examples of Volumetric Standards include but may not be limited to the following;

- laboratory glassware (see for example ASTM E288) and field measuring flasks (see NIST Handbook 105-2).
- steel graduated neck test measures as described in NIST Handbook 105-3 and in American Petroleum Institute's Manual of Petroleum Measurement Standards (Chapter 4). These include the steel 5 gallon capacity test measures commonly used by weights and measures officials to test retail motor fuel dispensers.
- pressurized Liquefied Petroleum Gas (LPG) Provers as described in NIST Handbook 105-4.
- slicker plate standards. These devices are similar to volumetric provers with the exception that they do not have a graduated neck. A slicker plate is used to skim off the meniscus formed at the top of the vessel when filled.

Volume measurements are further subdivided into two measurement categories. Volume standards are calibrated either by;

- transferring a known quantity of liquid (usually clean water) into them (See SOP's 16, 18, and 19 of NIST Internal Report 7383) –Volumetric Calibration–, or
- by filling it with a well characterized liquid (typically distilled water) and weighing it (See SOP 14 of NIST Internal Report 7383) –Gravimetric Calibration–.

Glassware

Description

The graphs on the next two pages represent the total number of volume measurements performed on glassware by the 44 reporting laboratories. Each map graph illustrates the geographical distribution of these measurements. The pie graphs located on each map for each individual lab and a larger pie graph that reflects the totals. The bar graph at the bottom of the page shows the same customer breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

- Of the 44 reporting laboratories, 0 labs performed a total of 0 volume transfer tests.
- Of the 44 reporting laboratories, 9 labs performed a total of 189 gravimetric volume tests.

Comparison of previous surveys

Year	# Labs	Volume Transfer	Gravimetric	Total
1996	29			1,205
1998	24			844
1999	25			853
2000	27			668
2002	24			555
2004	17			332
2005	20	69	140	209
2006	18	82	172	254
2008	18	42	183	225
2010	16	43	288	331
2010	16	43	288	331
2012	8	170	78	248
2014	9	124	119	243
2016	10	6	75	81
2018	9	0	104	104
2020	9	0	189	189

Table 16: Glassware calibrations from previous surveys.

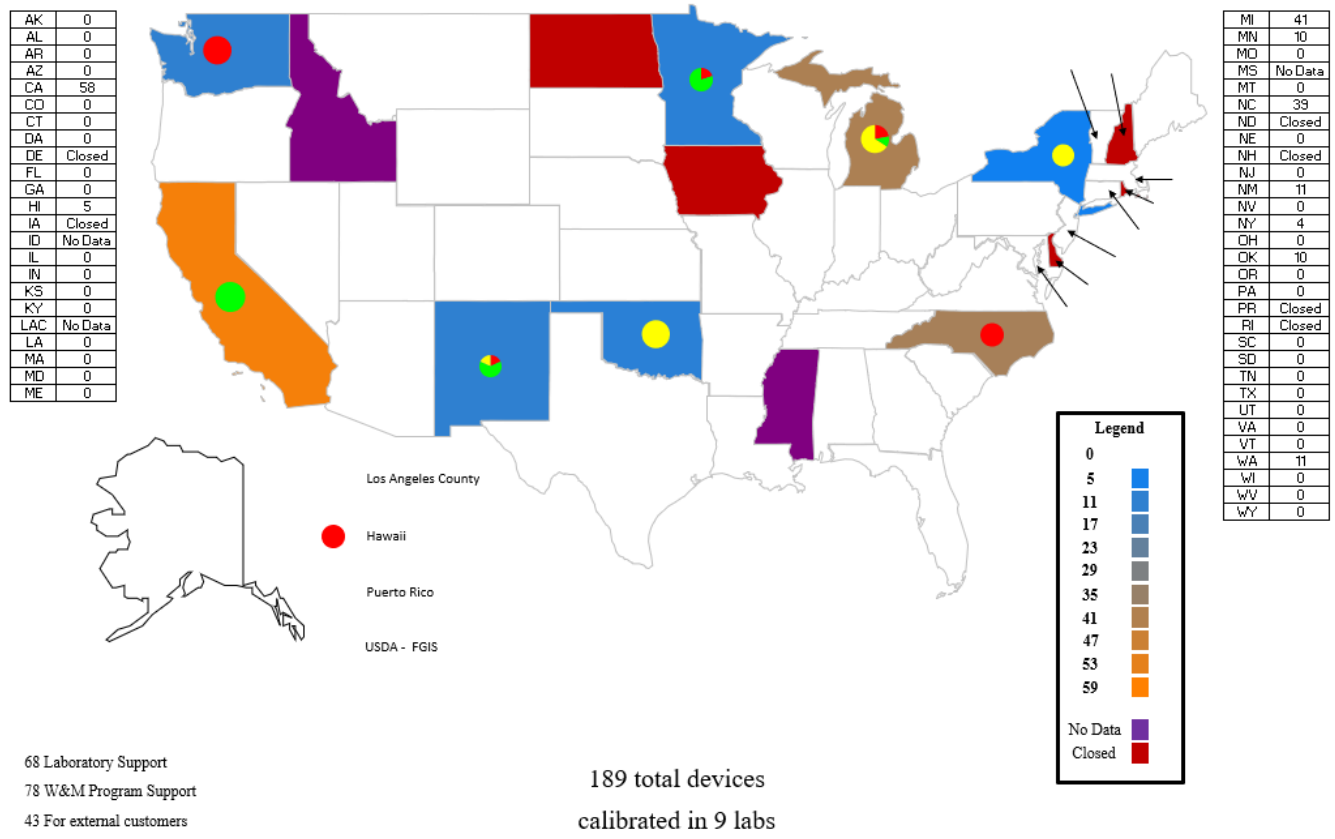
Notes and Comments

- 36 % of all glassware standards were tested for the laboratory
- 41 % of all glassware standards were tested for Weights and Measures enforcement programs.
- 23 % of all glassware standards were tested for external customers.

No Volumetric Glassware Tests to Report

Figure 11: Glassware calibrations, volume transfer method

Gravimetric



68 Laboratory Support
78 W&M Program Support
43 For external customers

189 total devices
calibrated in 9 labs

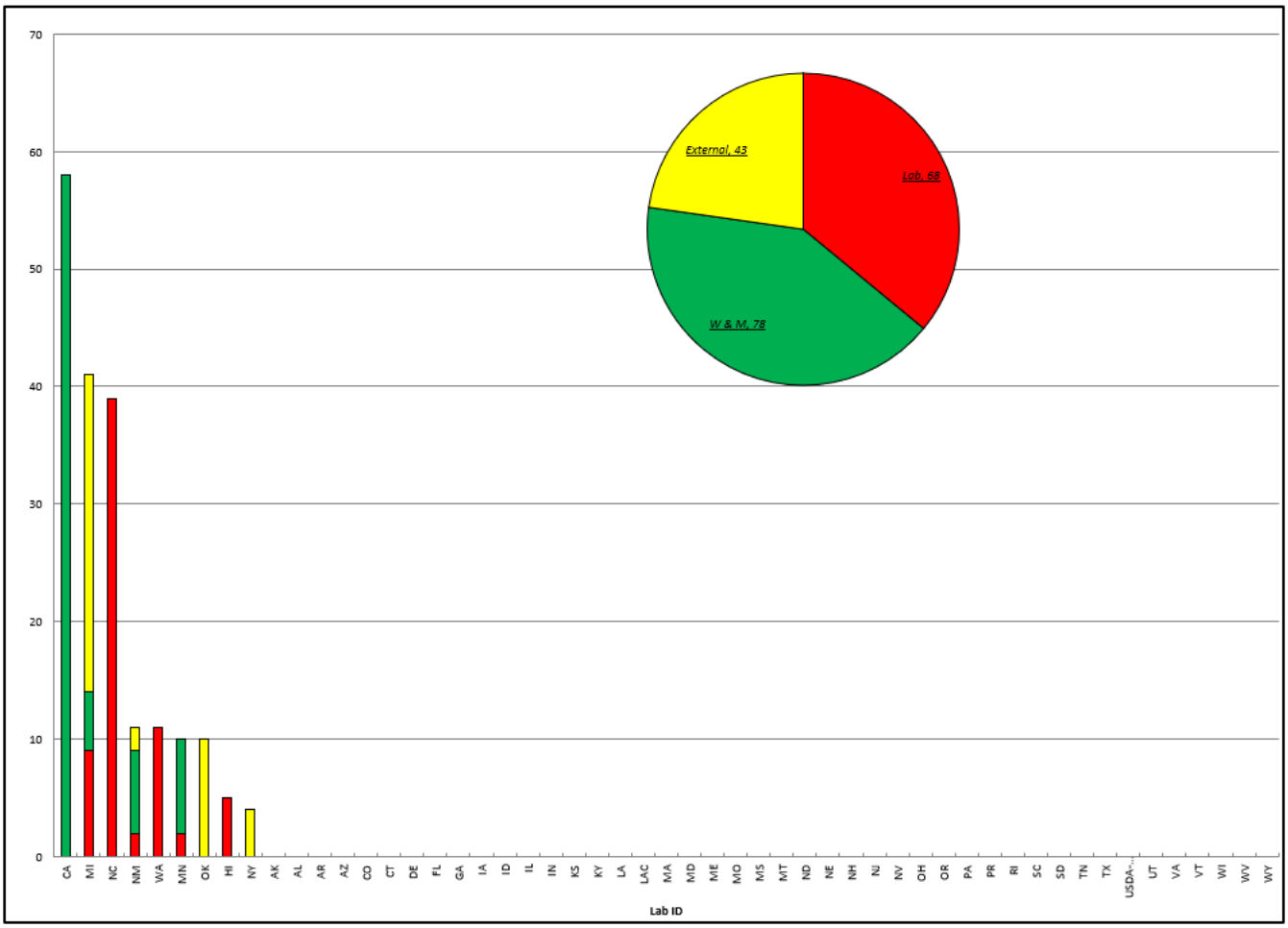


Figure 12: Glassware calibrations, gravimetric method.

Test Measures (≤5 gallon)

Description

The graphs on the next two pages represent the total number of volume measurements performed on test measures by the 44 reporting laboratories. Each map graph illustrates the geographical distribution of these measurements. The pie graphs located on each map for each individual lab and a larger pie graph that reflects the totals. The bar graph at the bottom of the page shows the same customer breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

- Of the 44 reporting laboratories, 43 labs performed a total of 7265 volume transfer tests.
- Of the 44 reporting laboratories, 15 labs performed a total of 53 gravimetric volume tests.

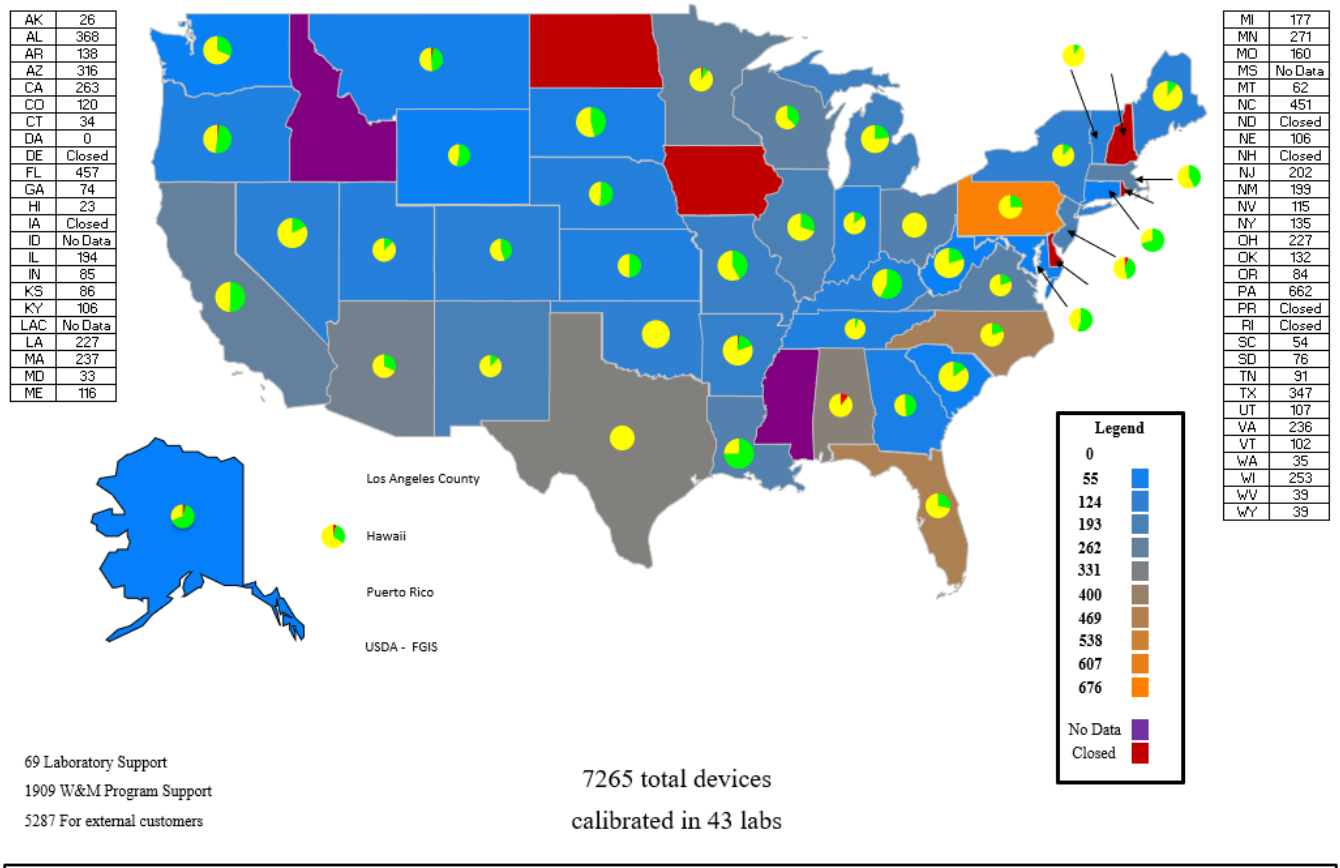
Comparison of previous surveys

Year	# Labs	Volume Transfer	Gravimetric	Total
1996	48	8290		8290
1998	46	6861		6861
1999	45	6986		6986
2000	45	7368		7368
2002	48	6966		6966
2004	46	6400		6400
2005	42	6925	75	7000
2006	46	7532	77	7609
2008	49	7321	69	7390
2010	45	8216	73	8289
2012	46	7533	93	7626
2014	46	7863	128	7991
2016	46	7926	84	8010
2018	44	8308	74	8341
2020	43	7265	53	7318

Table 17: Test Measure (5 ≤ gal.) volume tests from previous surveys.

Notes and Comments

- 1 % of all test measures were tested for the laboratory.
- 26 % of all test measures were tested for Weights and Measures enforcement programs.
- 73 % of all test measures were tested for external customers.



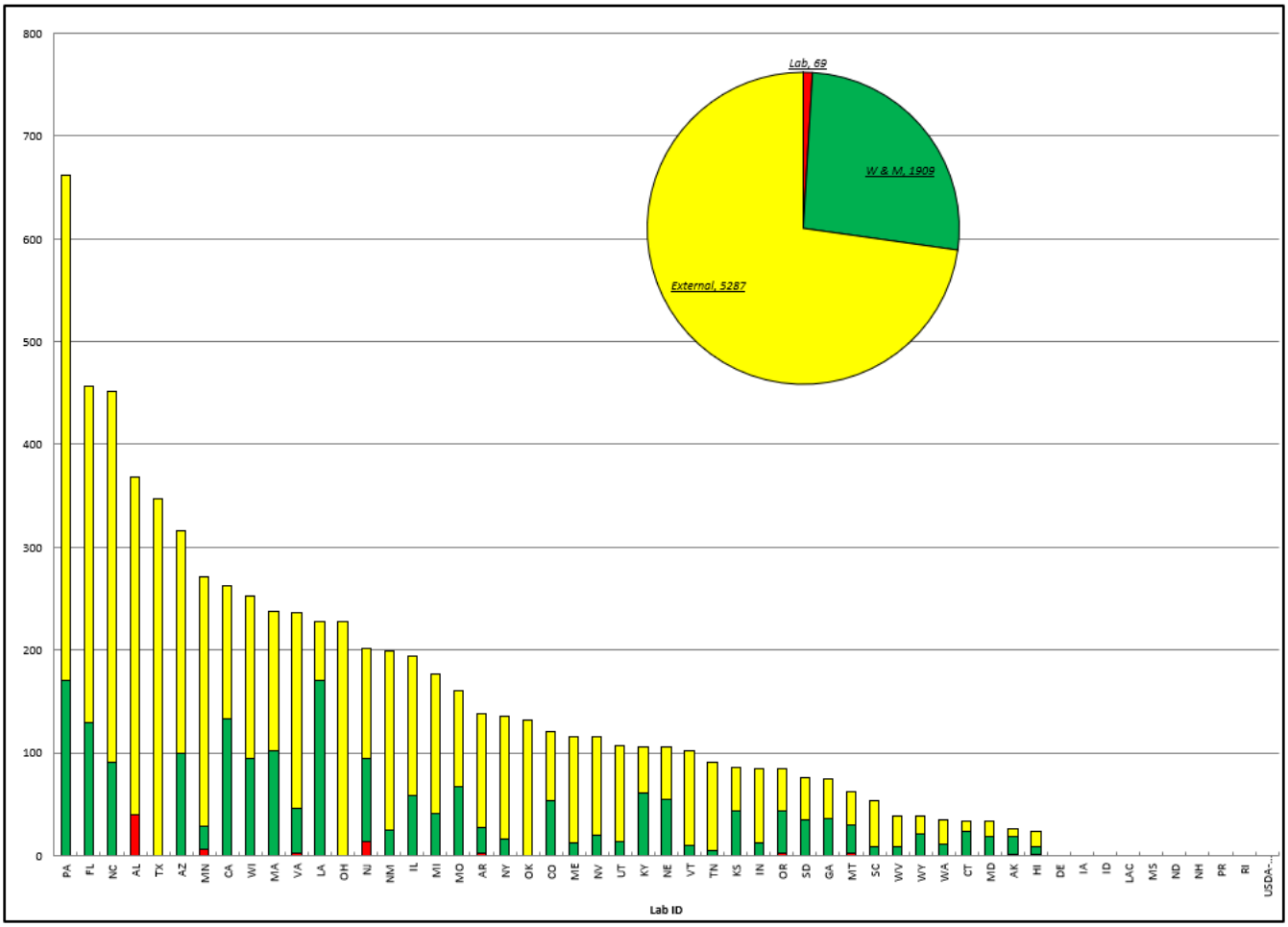
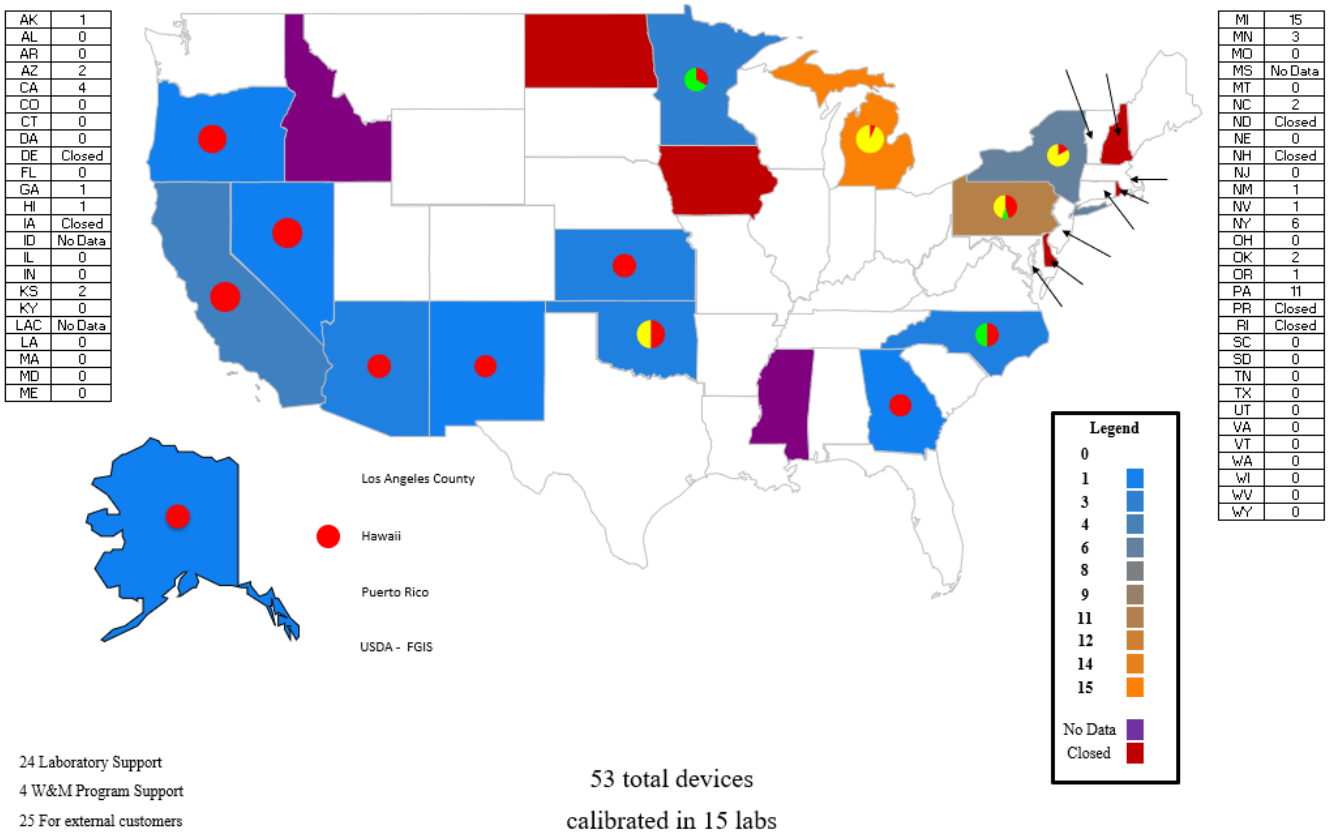


Figure 13: Test Measure tests (≤5 gallon), volume transfer.



24 Laboratory Support
4 W&M Program Support
25 For external customers

53 total devices
calibrated in 15 labs

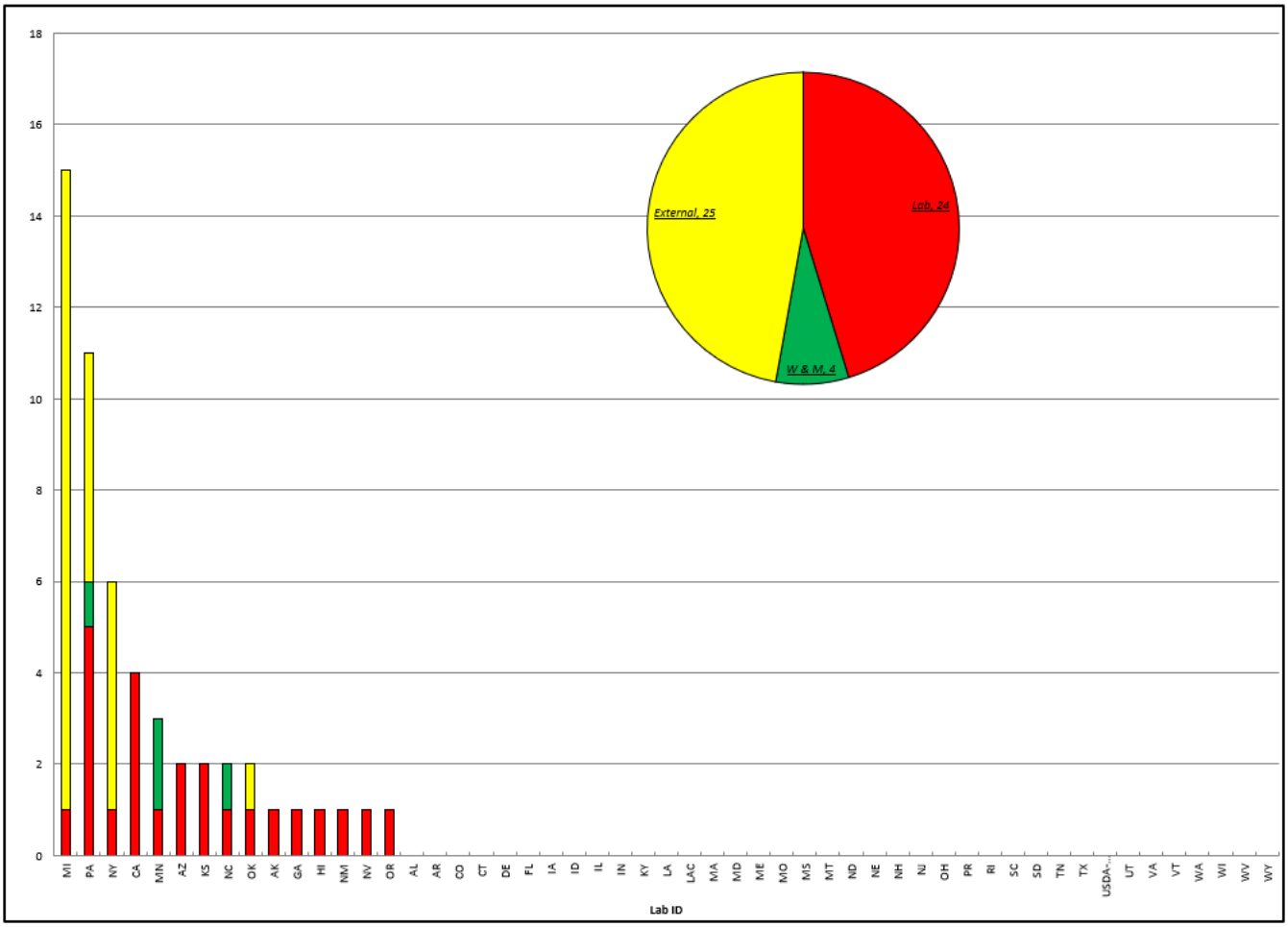


Figure 14: Test Measure tests (≤5 gallon), gravimetric.

Provers (> 5 gallon and ≤ 100 gallon)

Description

The graphs on the next two pages represent the total number of volume measurements performed on volumetric provers by the 44 reporting laboratories. Each map graph illustrates the geographical distribution of these measurements. The pie graphs located on each map for each individual lab and a larger pie graph that reflects the totals. The bar graph at the bottom of the page shows the same customer breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

- Of the 44 reporting laboratories, 37 labs performed a total of 757 volume transfer tests.
- Of the 44 reporting laboratories, 10 labs performed a total of 33 gravimetric volume tests.

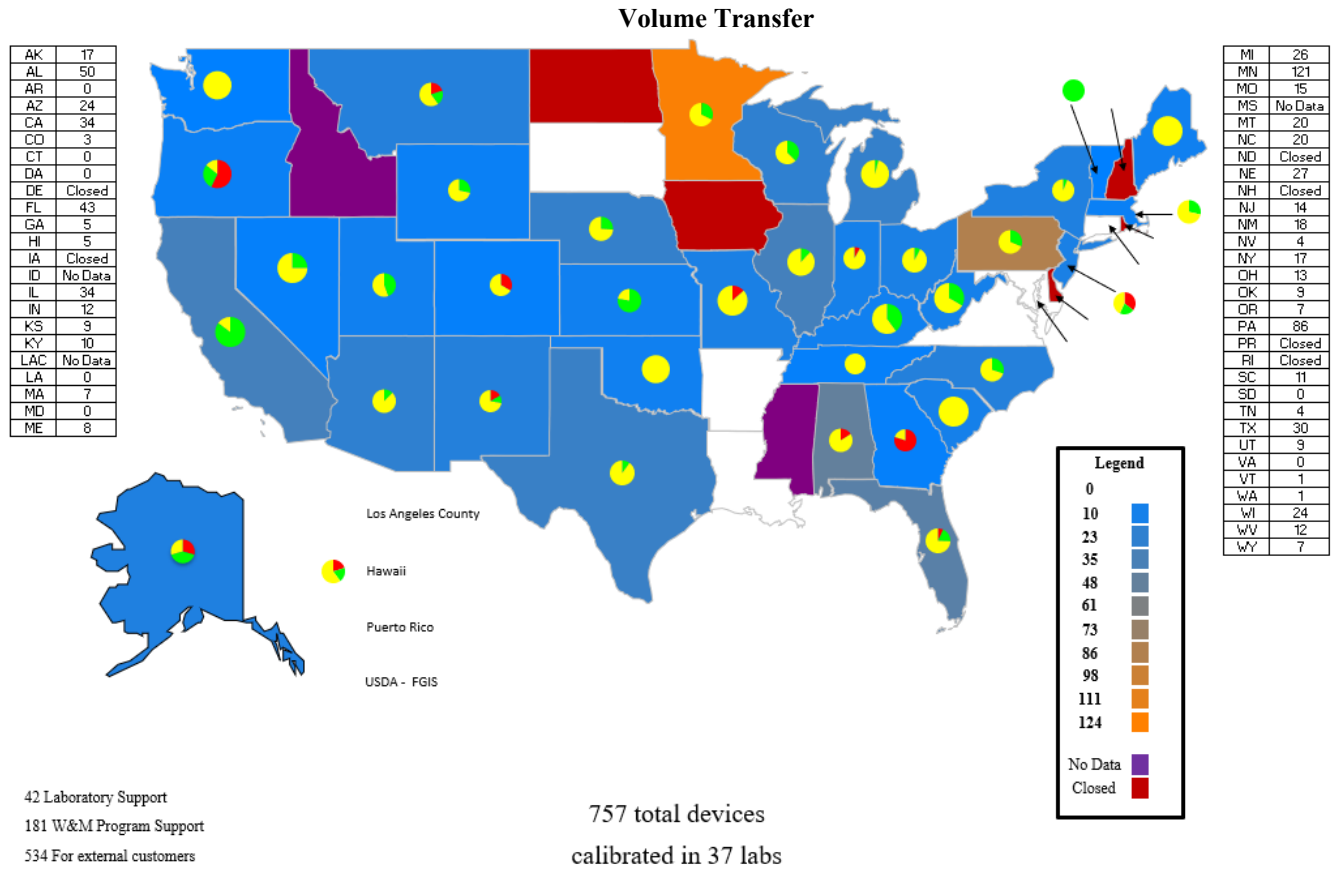
Comparison of previous surveys

Year	# Labs	Volume Transfer	Gravimetric	Total
2005		726	47	773
2006		760	81	841
2008		737	46	783
2010	41	711	49	760
2012	39	713	31	744
2014	37	828	57	885
2016	39	745	58	803
2018	38	841	61	902
2020	37	757	33	790

Table 18: Provers (>5 gal. and ≤ 100 gal.) volume tests from previous surveys.

Notes and Comments

- 7 % of all provers (> 5 gal. and ≤ 100 gal.) were tested for the laboratory
- 23 % of all provers (> 5 gal. and ≤ 100 gal.) were tested for Weights and Measures enforcement programs.
- 70 % of all provers (> 5 gal. and ≤ 100 gal.) were tested for external customers.



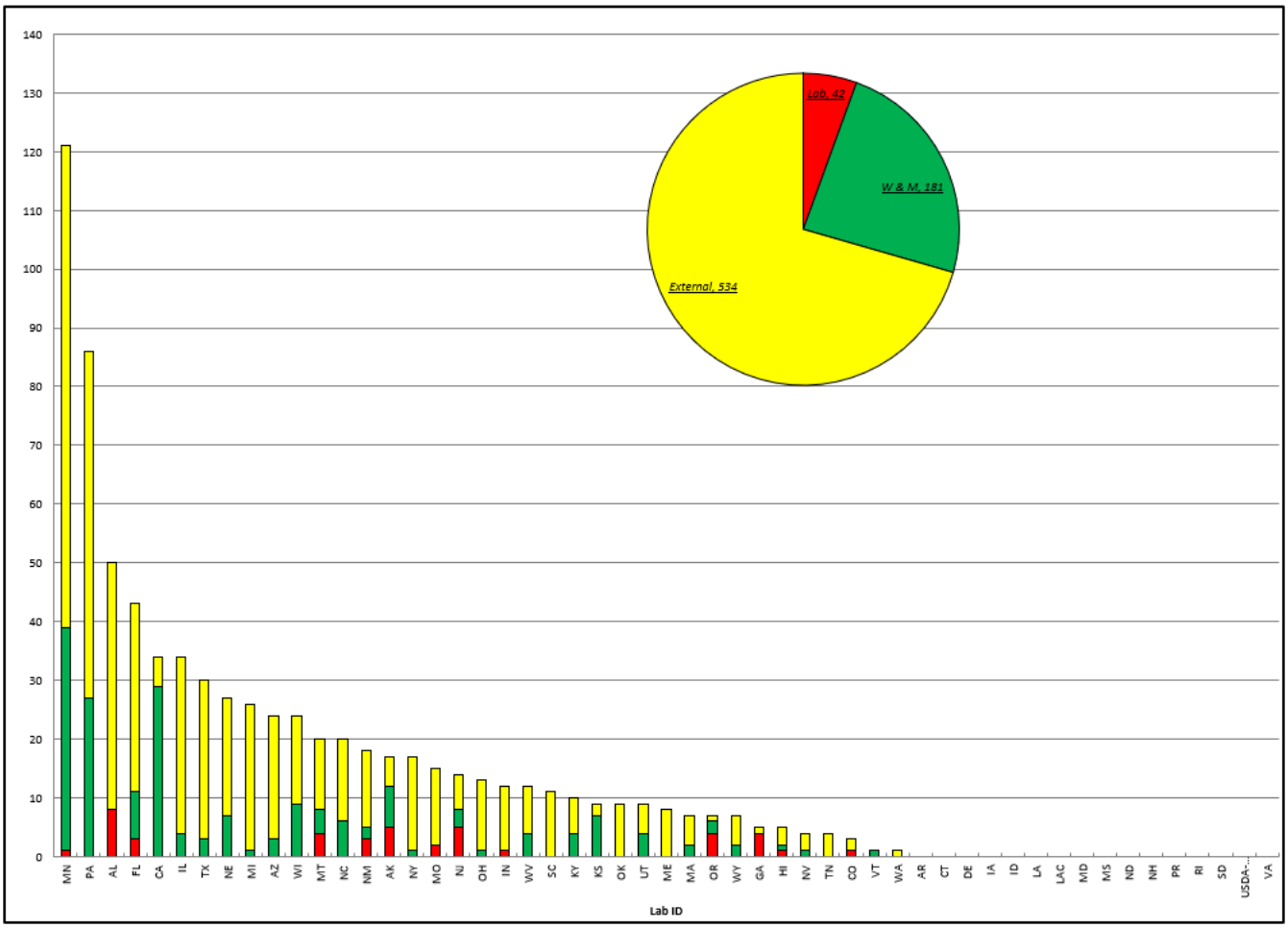
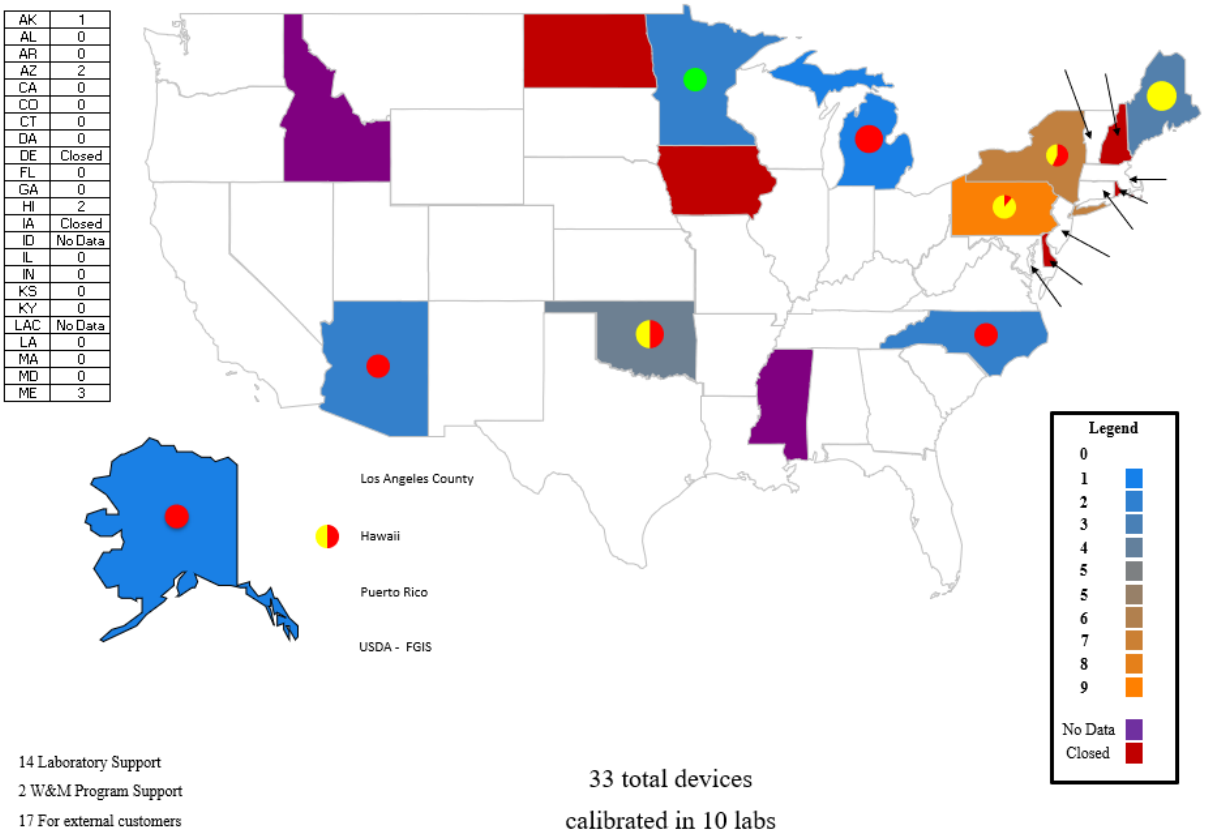


Figure 15: Prover (≥5 gal. and < 100 gal.) tests, volume transfer.

Gravimetric

AK	1
AL	0
AR	0
AZ	2
CA	0
CO	0
CT	0
DA	0
DE	Closed
FL	0
GA	0
HI	2
IA	Closed
ID	No Data
IL	0
IN	0
KS	0
KY	0
LAC	No Data
LA	0
MA	0
MD	0
ME	3



MI	1
MN	2
MO	0
MS	No Data
MT	0
NC	2
ND	Closed
NE	0
NH	Closed
NJ	0
NM	0
NV	0
NY	7
OH	0
OK	4
OR	0
PA	9
PR	Closed
RI	Closed
SC	0
SD	0
TN	0
TX	0
UT	0
VA	0
VT	0
WA	0
WI	0
WV	0
WY	0

14 Laboratory Support
2 W&M Program Support
17 For external customers

33 total devices
calibrated in 10 labs

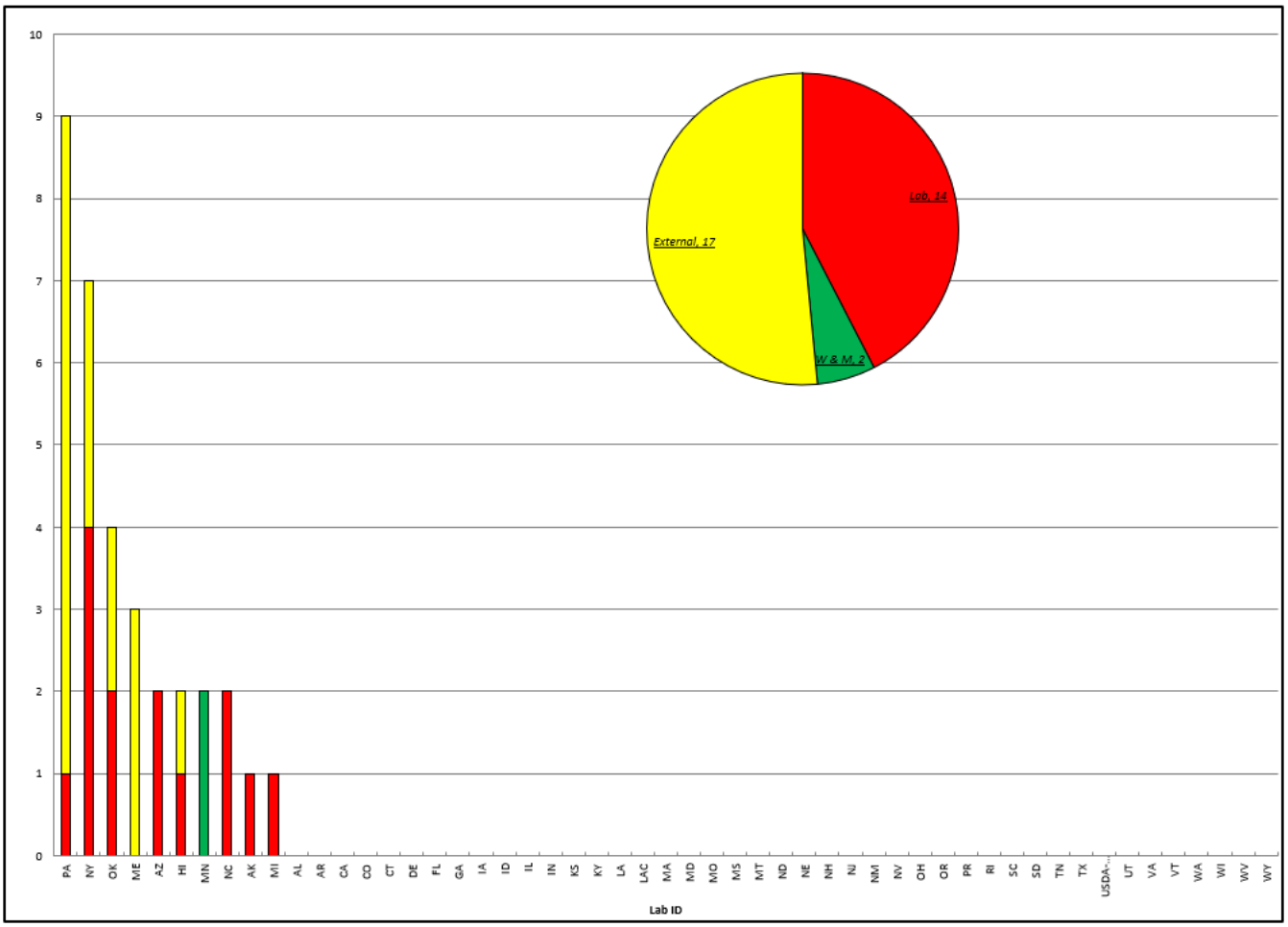


Figure 16: Prover (≥5 gal. and < 100 gal.) tests, gravimetric.

Provers (> 100 gallon)

Description

The graphs on the next two pages represent the total number of volume measurements performed on volumetric provers by the 44 reporting laboratories. Each map graph illustrates the geographical distribution of these measurements. The pie graphs located on each map for each individual lab and a larger pie graph that reflects the totals. The bar graph at the bottom of the page shows the same customer breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

- Of the 44 reporting laboratories, 29 labs performed a total of 284 volume transfer tests.
- Of the 44 reporting laboratories, 0 labs performed 0 gravimetric volume tests.

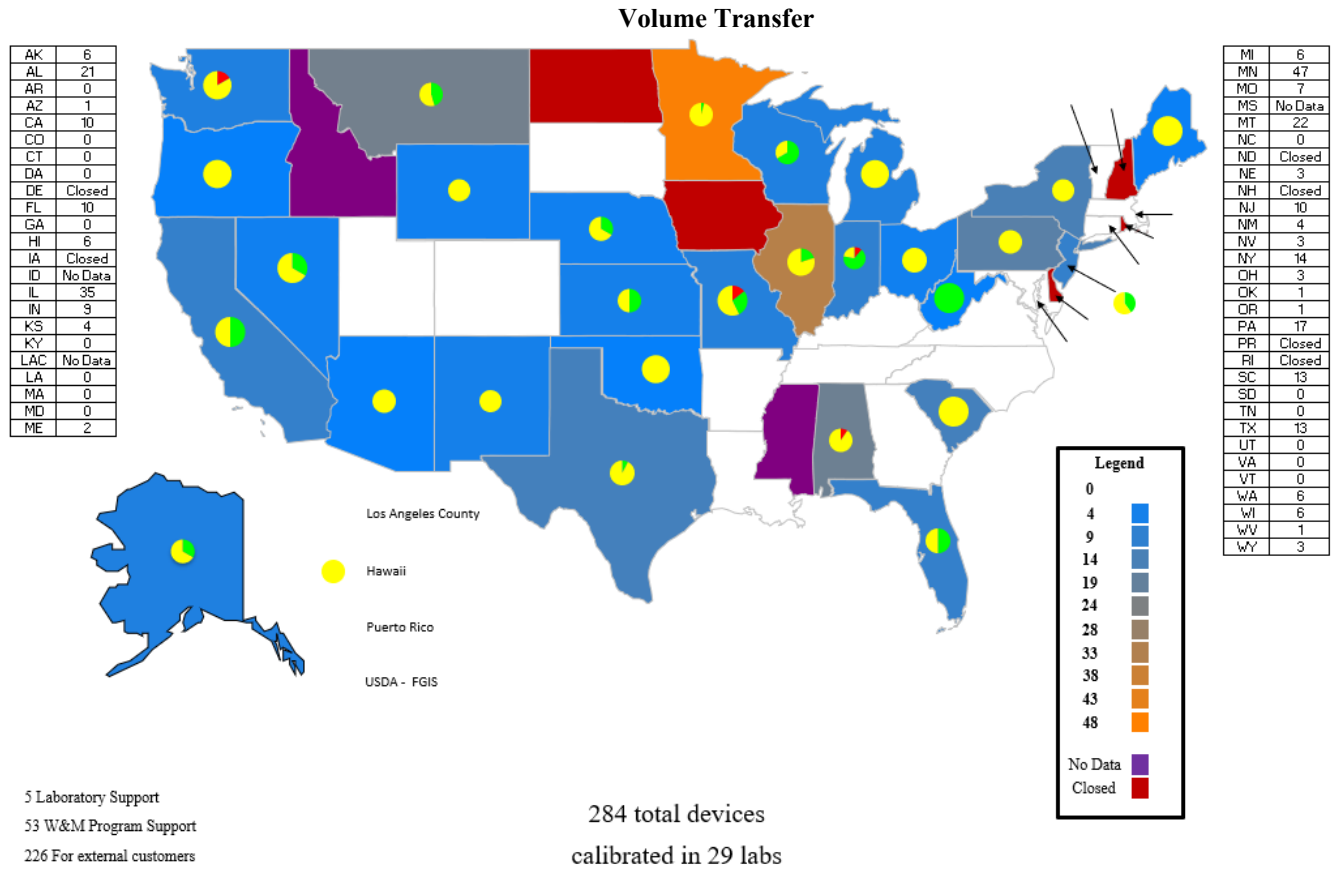
Comparison of previous surveys

Year	# Labs	Volume Transfer	Gravimetric	Total
2005		201	1	202
2006		202	0	202
2008	34	284	0	284
2010	33	287	0	287
2012	30	237	1	238
2014	30	239	1	240
2016	30	275	3	278
2018	28	259	1	260
2020	29	284	0	284

Table 19: Provers (> 100 gal.) tests from previous surveys.

Notes and Comments

- 2 % of all provers (> 100 gal.) were tested for the laboratory.
- 18 % of all provers (> 100 gal.) were tested for Weights and Measures enforcement programs.
- 80 % of all provers (> 100 gal.) were tested for external customers.



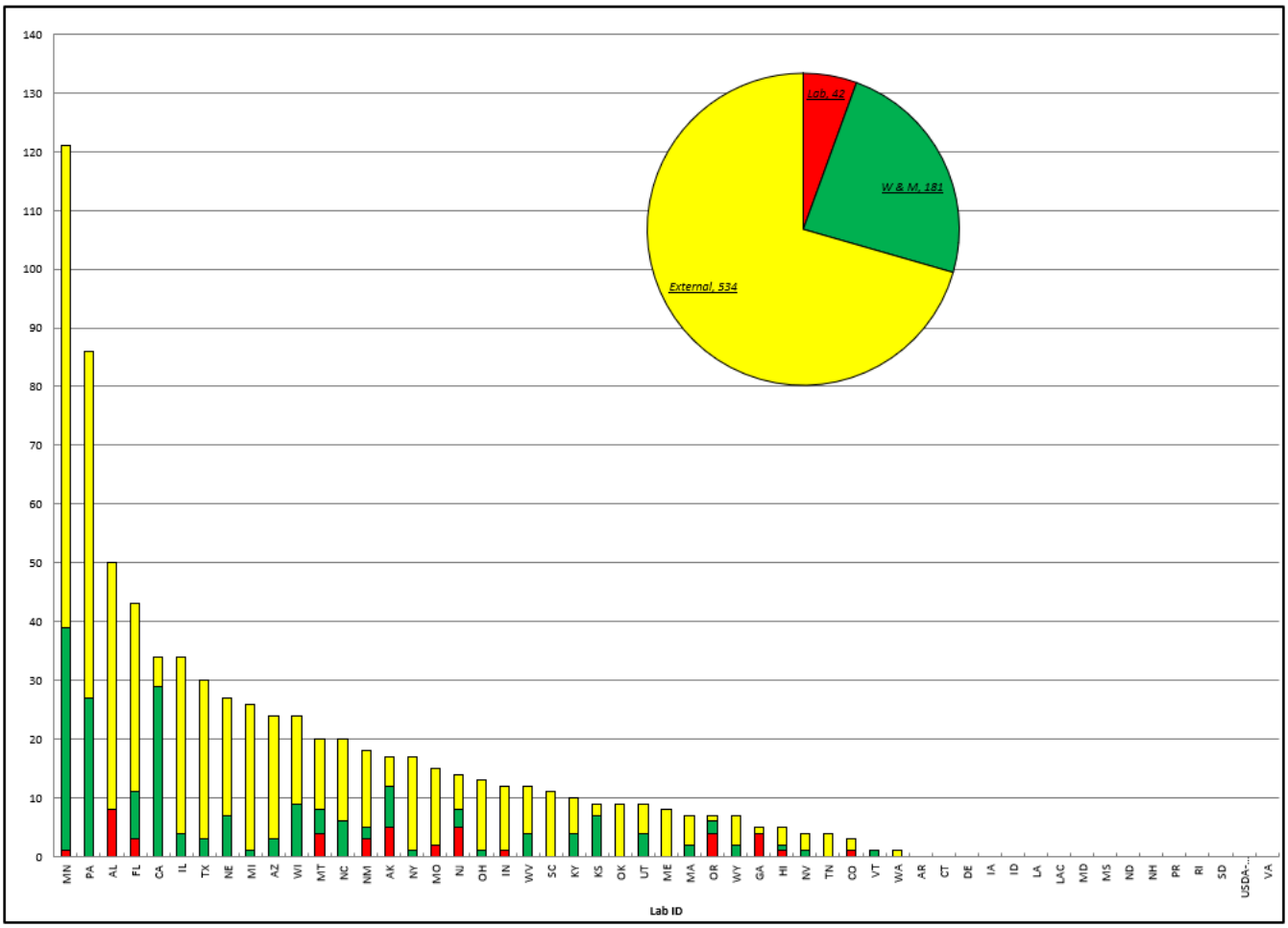


Figure 17: Prover (>100 gal.) tests, volume transfer

No Gravimetric Volume Tests to Report

Figure 18: Prover (>100 gal.) tests, gravimetric

Liquefied Petroleum Gas (LPG) Provers

Description

The graphs on the next two pages represent the total number of measurements performed on LPG provers by the 44 reporting laboratories. Each map graph illustrates the geographical distribution of these measurements. The pie graphs located on each map for each individual lab and a larger pie graph that reflects the totals. The bar graph at the bottom of the page shows the same customer breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

- Of the 44 reporting laboratories, 23 labs performed a total of 259 volume transfer tests.

Comparison of previous surveys

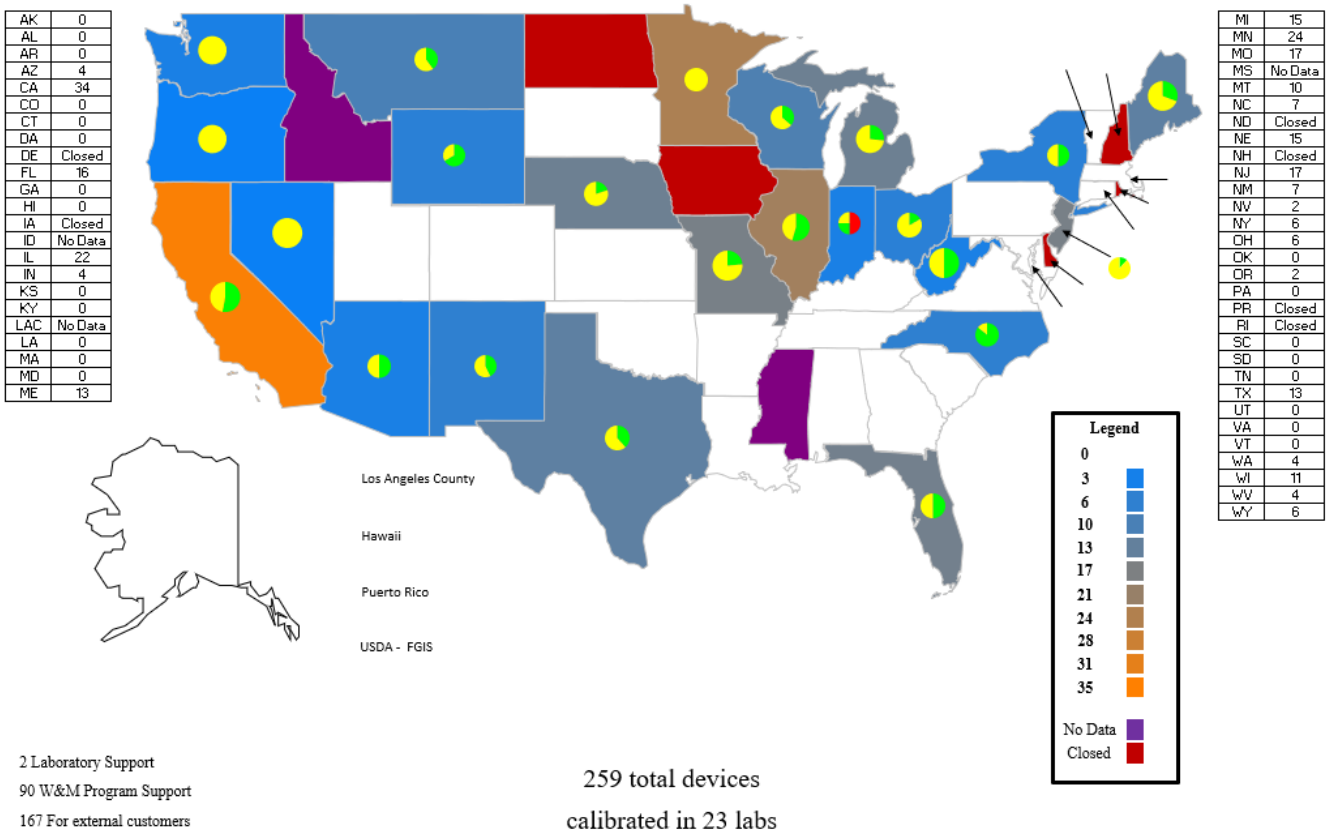
Year	# Labs	Volume Transfer
2005		226
2006		239
2008	27	249
2010	33	304
2012	24	228
2014	25	231
2016	25	253
2018	29	292
2020	23	259

Table 20: LPG Prover volume tests from previous surveys[7].

Notes and Comments

- 1 % of all LPG provers were tested for the laboratory.
- 35 % of all LPG provers were tested for Weights and Measures enforcement programs.
- 64 % of all LPG provers were tested for external customers.

[7] Prior editions of the survey included a survey of gravimetric testing of LPG style provers. This question was deleted in the 2016 edition. Laboratories have consistently reported performing no such measurements.



2 Laboratory Support
90 W&M Program Support
167 For external customers

259 total devices
calibrated in 23 labs

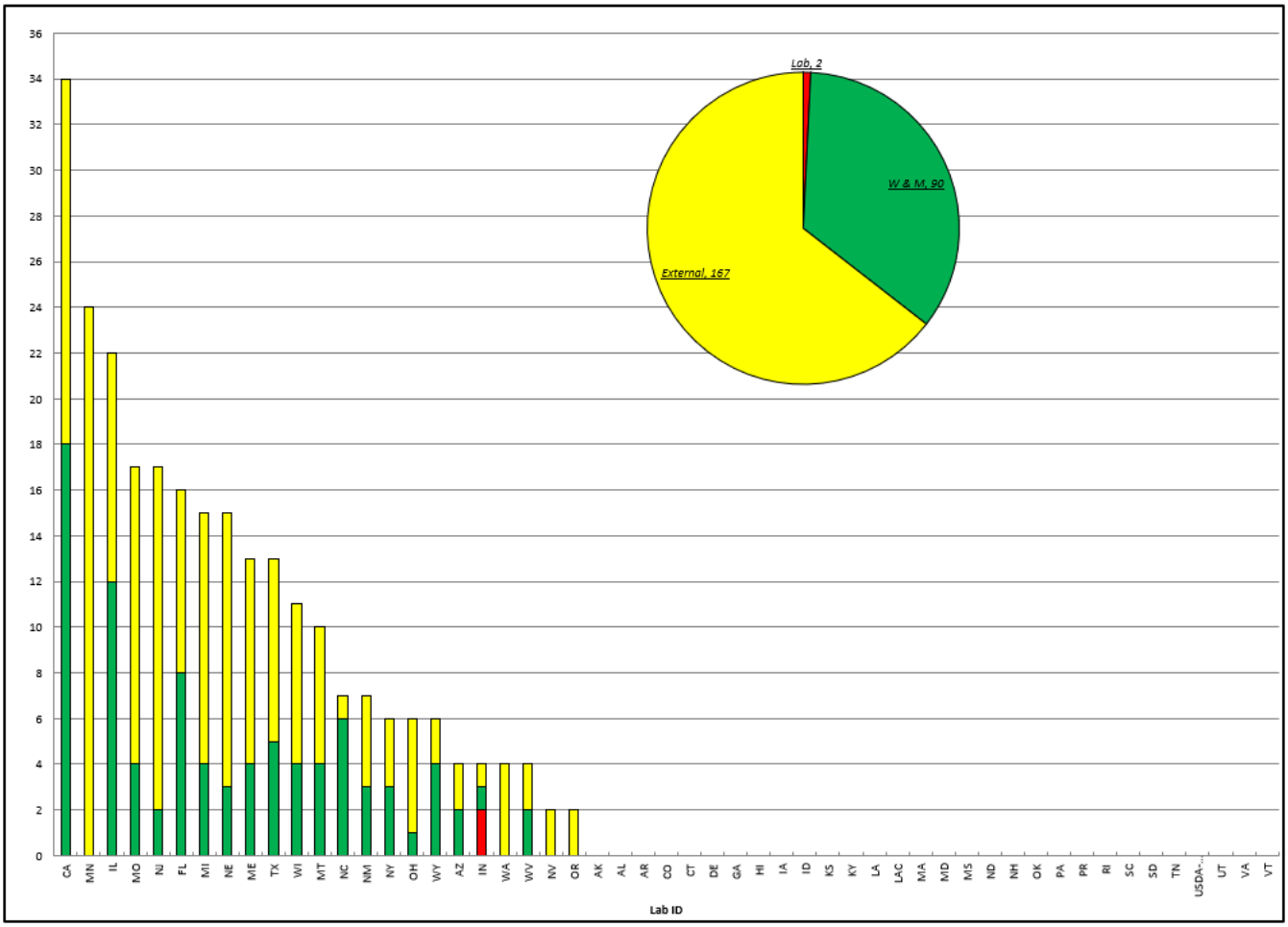


Figure 19: LPG Prover tests, volume transfer

Findings

(This section was deprecated in 2018 however prior history data has been retained in this report for convenience. See the new section titled “Small Volume Provers, Compact Displacement Provers, and Closed Loop Provers”)

Year	# Labs	Gravimetric	Volume Transfer	Total
2005		11	0	11
2006		20	0	20
2008	3	16	11	27 [MI,NC,VT]
2010	2	30	0	30 [MI,NC]
2012	3	57	0	57
2014	4	32	3	35
2016	3	31	0	31[AZ,MI,NC]

Table 21: SVP tests from previous surveys.

Small Volume Provers, Compact Displacement Provers, and Closed Loop Provers

Description

The graphs on the next two pages represent the total number of measurements performed on small volume provers, compact displacement provers, and closed loop provers by the 44 reporting laboratories. Each map graph illustrates the geographical distribution of these measurements. The pie graphs located on each map for each individual lab and a larger pie graph that reflects the totals. The bar graph at the bottom of the page shows the same customer breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

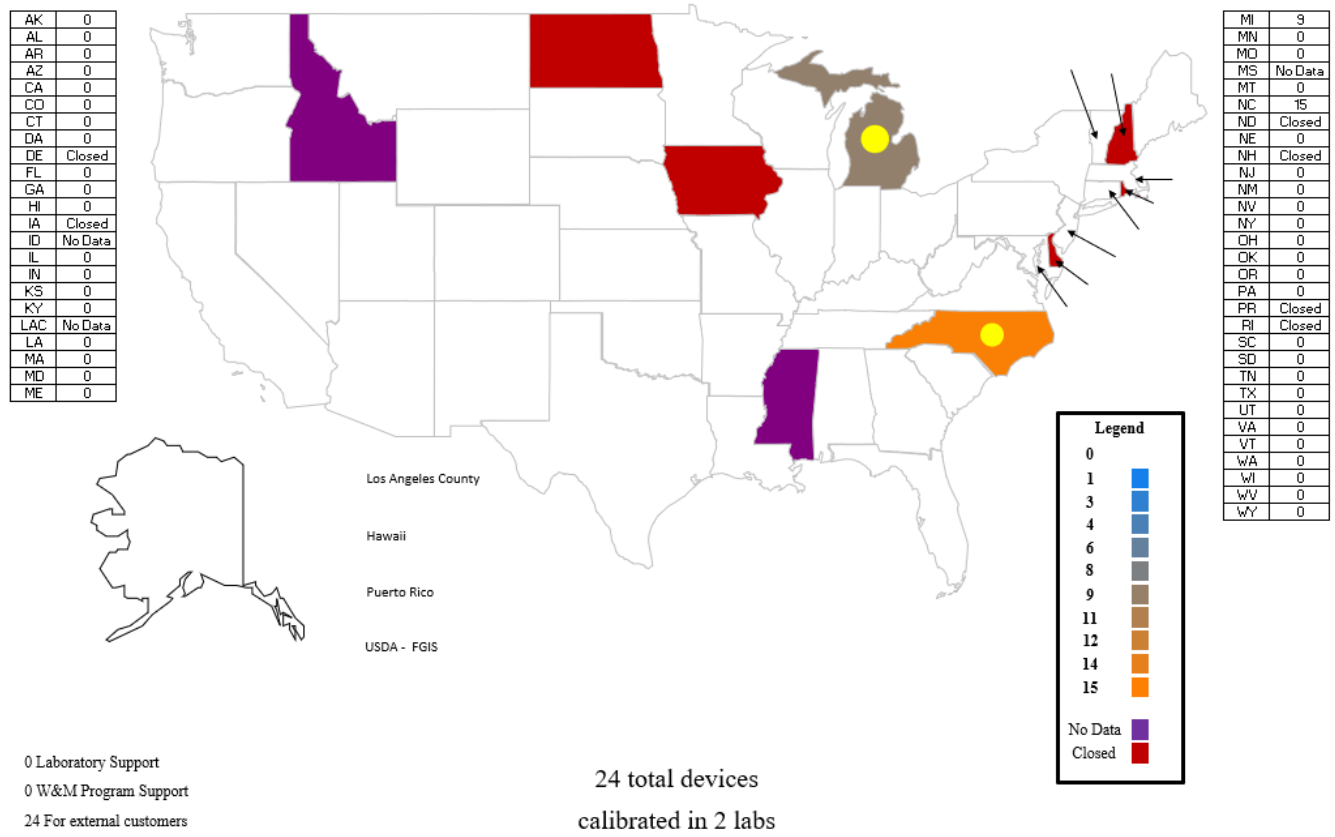
Findings

- Of the 44 reporting laboratories, 2 labs performed a total of 24 tests.

Comparison of previous surveys

Year	# Labs	Total Devices
2018	2	28
2020	2	24

Table 22: Small Volume, Compact Displacement, and Closed Loop prover tests.



0 Laboratory Support
0 W&M Program Support
24 For external customers

24 total devices
calibrated in 2 labs

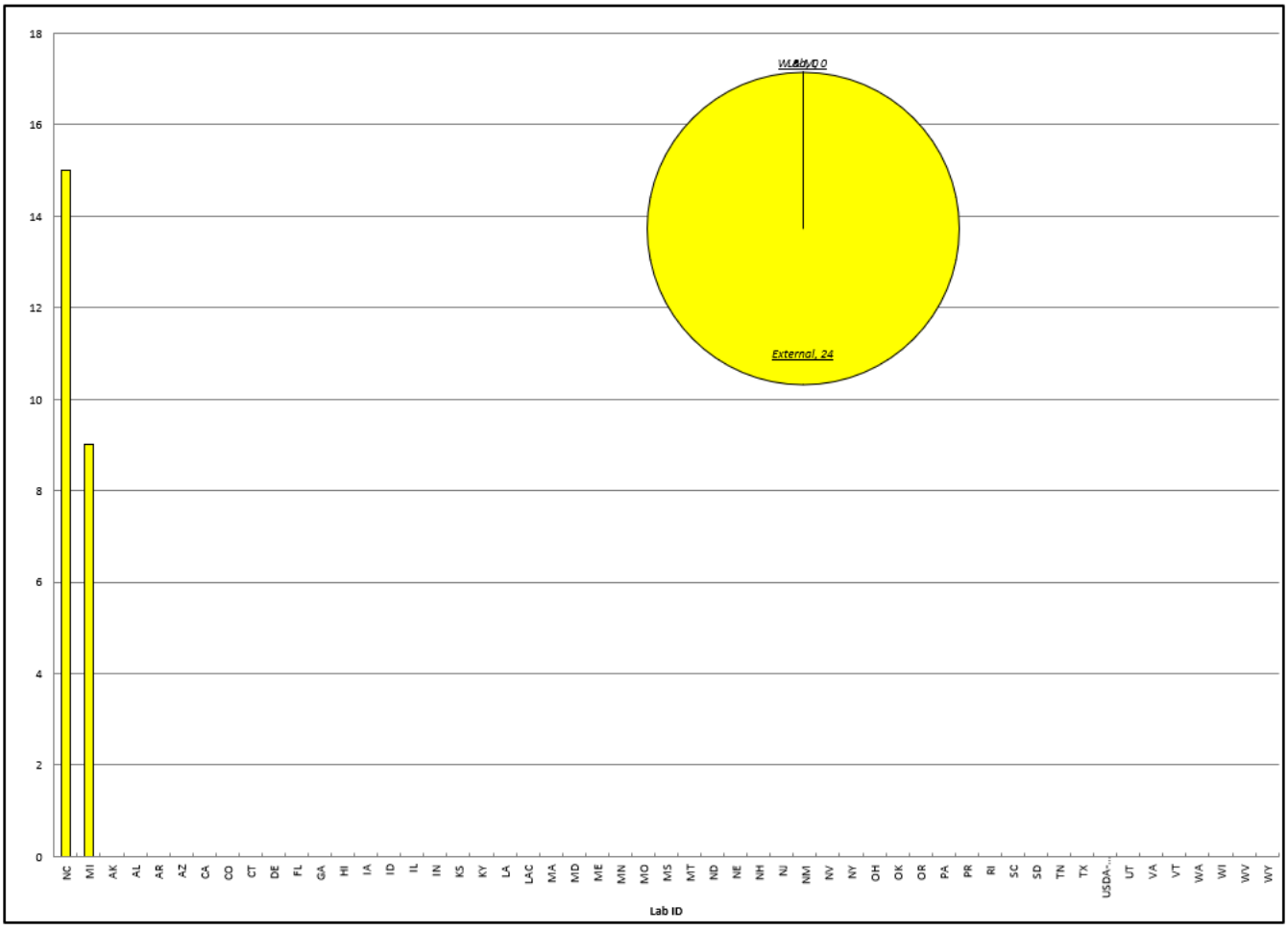


Figure 20: Small Volume, Compact Displacement, and Closed Loop prover tests

Temperature

Description

The graphs on the next page represent the total number of measurements performed on temperature sensing devices by the 44 reporting laboratories. Each map graph illustrates the geographical distribution of these measurements. The pie graphs located on each map for each individual lab and a larger pie graph that reflects the totals. The bar graph at the bottom of the page shows the same customer breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

Of the 44 reporting laboratories, 5 labs tested a total of 216 temperature standards

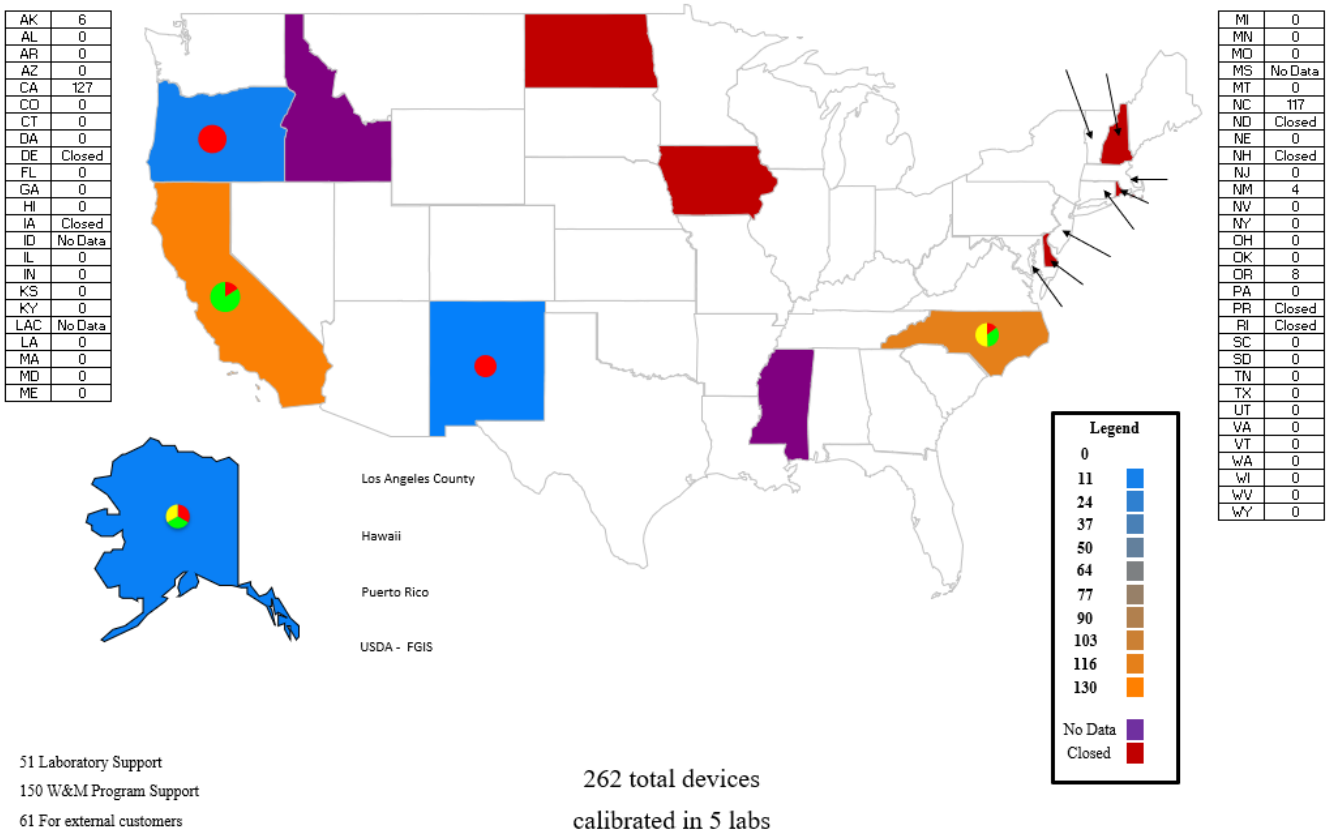
Comparison of previous surveys

Year	# Labs	Total Devices
1996	20	447
1998	11	378
1999	12	514
2000	16	460
2002	13	456
2004	12	315
2005	15	418
2006	12	281
2008	13	498
2010	11	465
2012	7	191
2014	6	192
2016	6	242
2018	5	216
2020	5	262

Table 23: Temperature standard tests from previous surveys.

Notes and Comments

- 20 % of all temperature standards were tested for internal use by the laboratory.
- 57 % of all temperature standards were tested for the weight and measures program.
- 23 % of all temperature standards were tested for external customers.



51 Laboratory Support
150 W&M Program Support
61 For external customers

262 total devices
calibrated in 5 labs

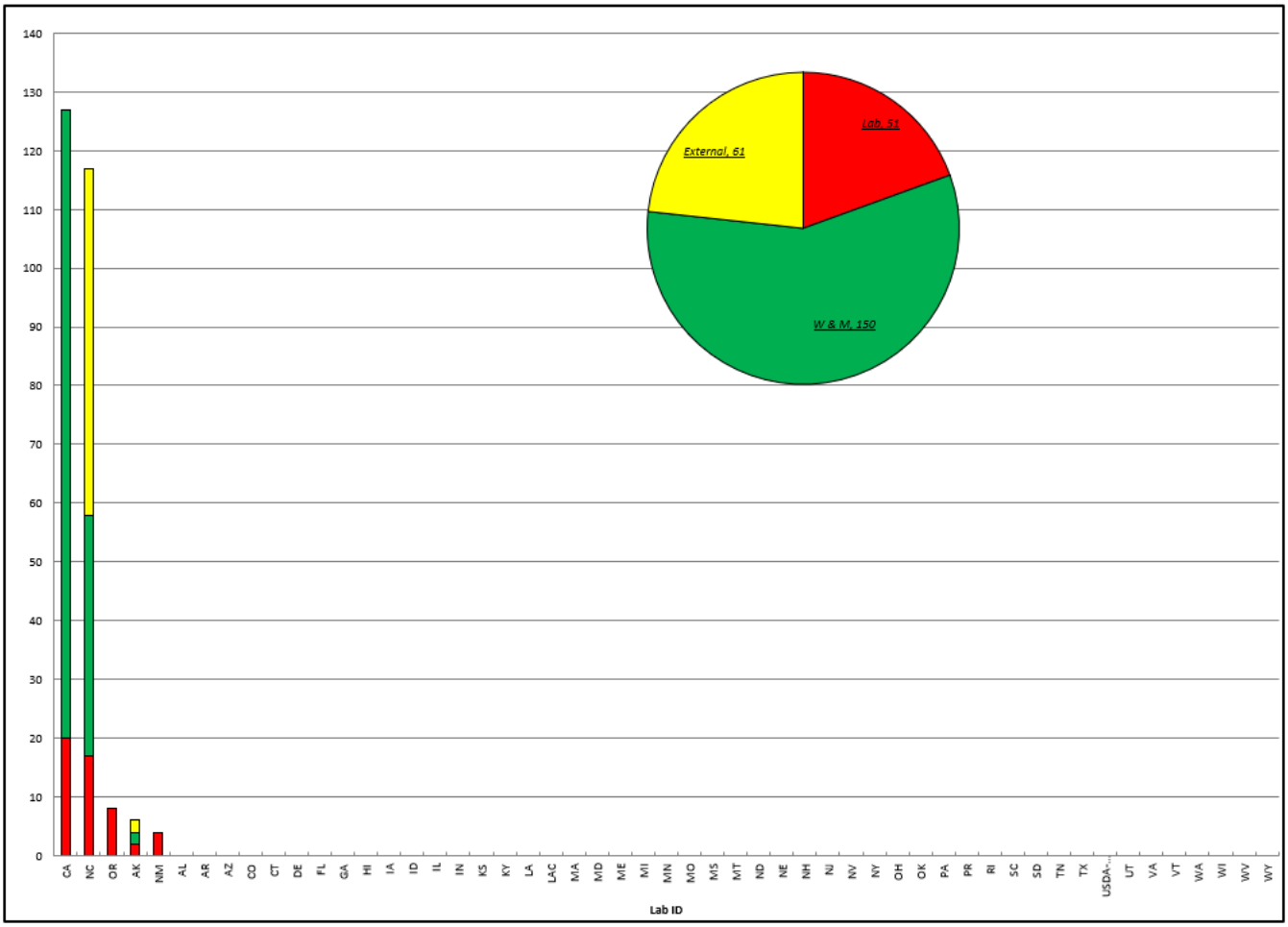


Figure 21: Temperature standard tests.

Frequency

Description

The graphs on the next page represent the total number of measurements performed on frequency standards by the 44 reporting laboratories. Each map graph illustrates the geographical distribution of these measurements. The pie graphs located on each map for each individual lab and a larger pie graph that reflects the totals. The bar graph at the bottom of the page shows the same customer breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

Of the 44 reporting laboratories, 3 labs tested a total of 12.083 frequency standards

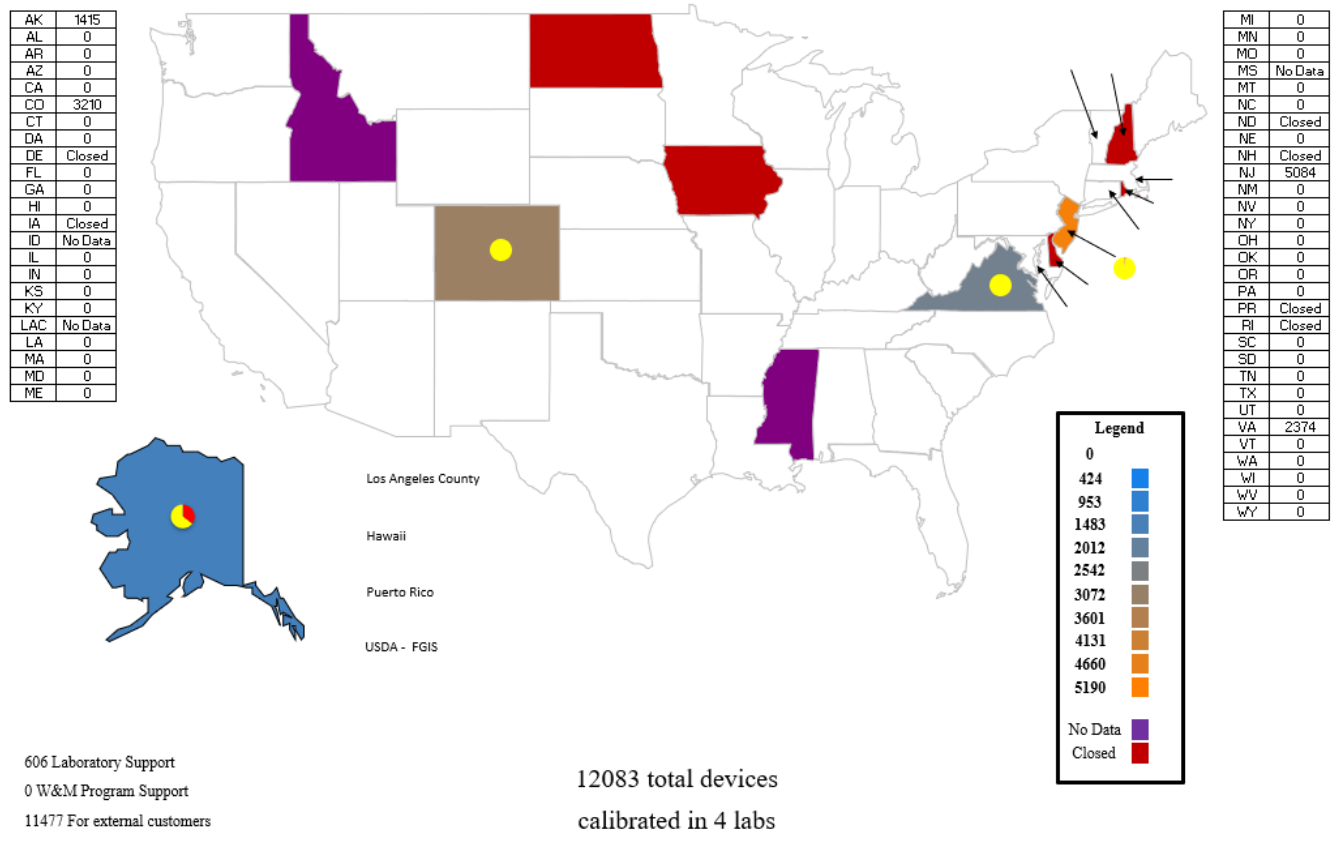
Comparison of previous surveys

Year	# Labs	Total Devices
1996	6	12,518
1998	4	11,561
1999	5	13,518
2000	7	14,670
2002	6	13,785
2004	3	14,772
2005	4	15,162
2006	4	14,832
2008	4	15,058
2010	4	17,580
2012	4	14,177
2014	4	13,282
2016	4	14,501
2018	3	10,054
2020	4	12,083

Table 24: Frequency standard tests from previous surveys.

Notes and Comments

- 5 % of all frequency standards were tested for internal use by the laboratory.
- 0 % of all frequency standards were tested for the weight and measures program.
- 95 % of all frequency standards were tested for external customers.



606 Laboratory Support
0 W&M Program Support
11477 For external customers

12083 total devices
calibrated in 4 labs

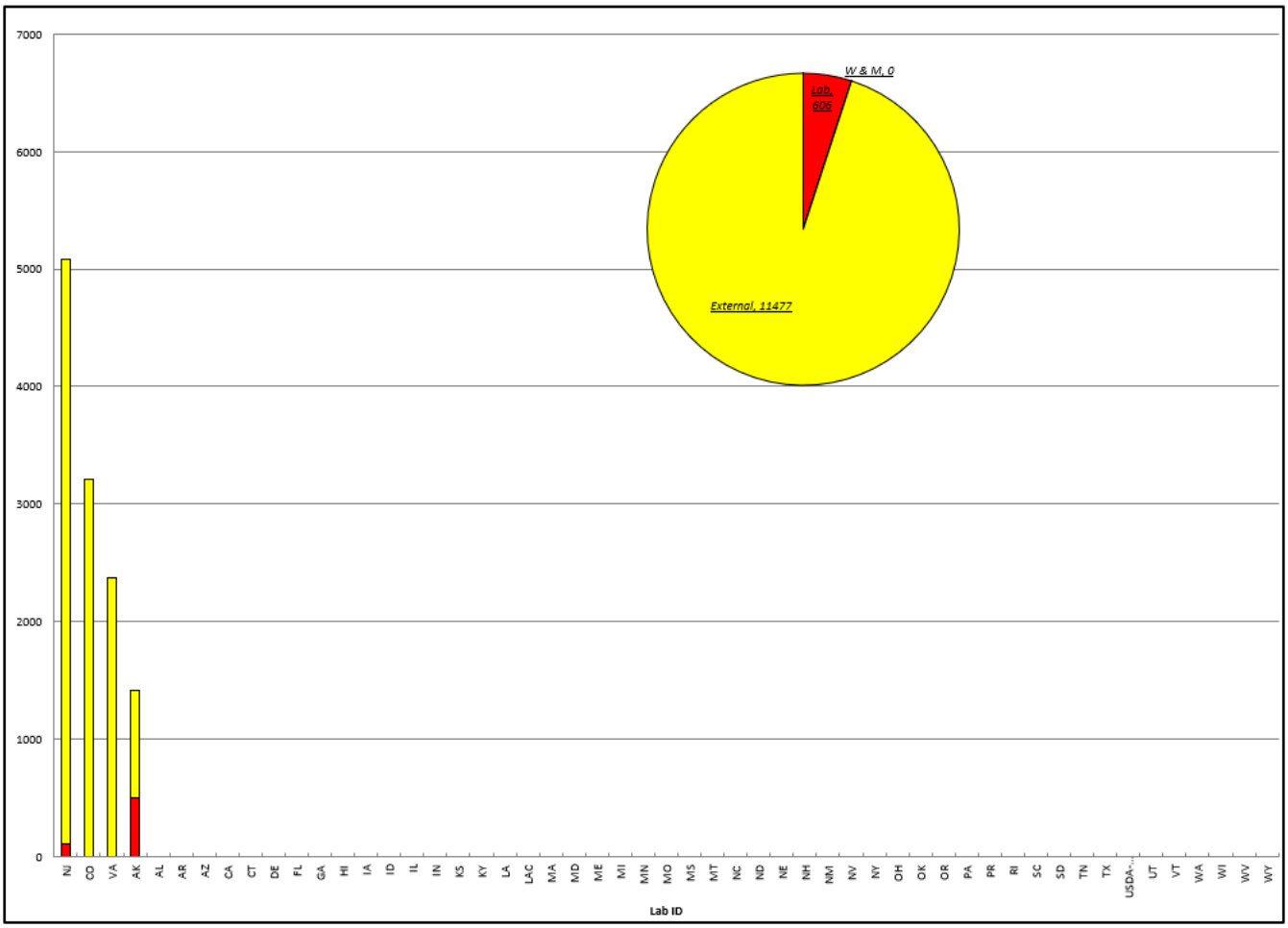


Figure 22: Frequency standard tests

Timing Devices

Description

The graphs on the next page represent the total number of measurements performed on timing devices by the 44 reporting laboratories. Each map graph illustrates the geographical distribution of these measurements. The pie graphs located on each map for each individual lab and a larger pie graph that reflects the totals. The bar graph at the bottom of the page shows the same customer breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

Of the 44 reporting laboratories, 9 labs tested a total of 572 timing devices

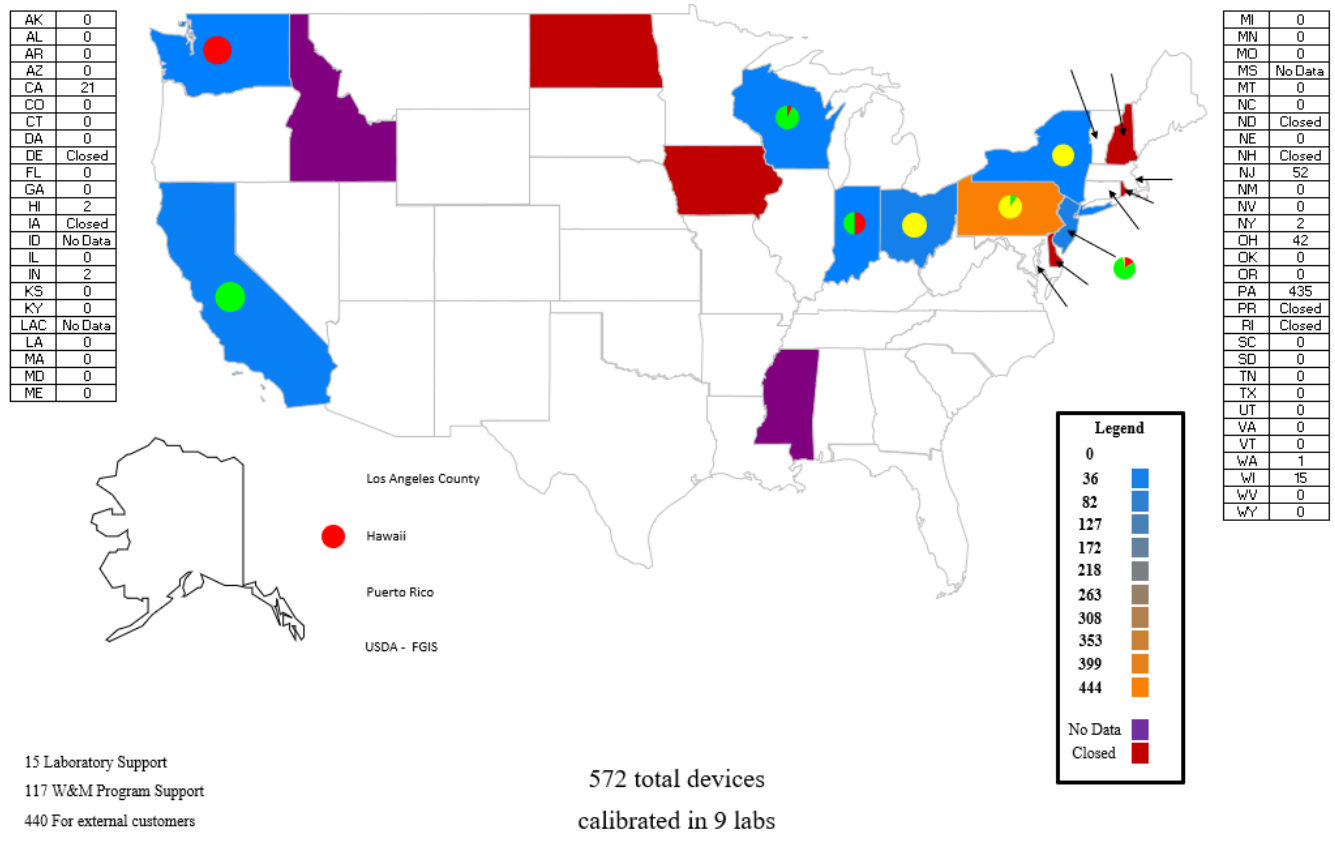
Comparison of previous surveys

Year	# Labs	Total Devices
1996	13	161
1998	11	380
1999	14	451
2000	13	554
2002	11	479
2004	9	951
2005	8	387
2006	11	365
2008	11	401
2010	9	339
2012	10	577
2014	7	600
2016	8	506
2018	9	4306
2020	9	572

Table 25: Timing devices tests from previous surveys

Notes and Comments

- 3 % of all timing devices were tested for internal use by the laboratory.
- 20 % of all timing devices were tested for the weight and measures program.
- 77 % of all timing devices were tested for external customers.



15 Laboratory Support
117 W&M Program Support
440 For external customers

572 total devices
calibrated in 9 labs

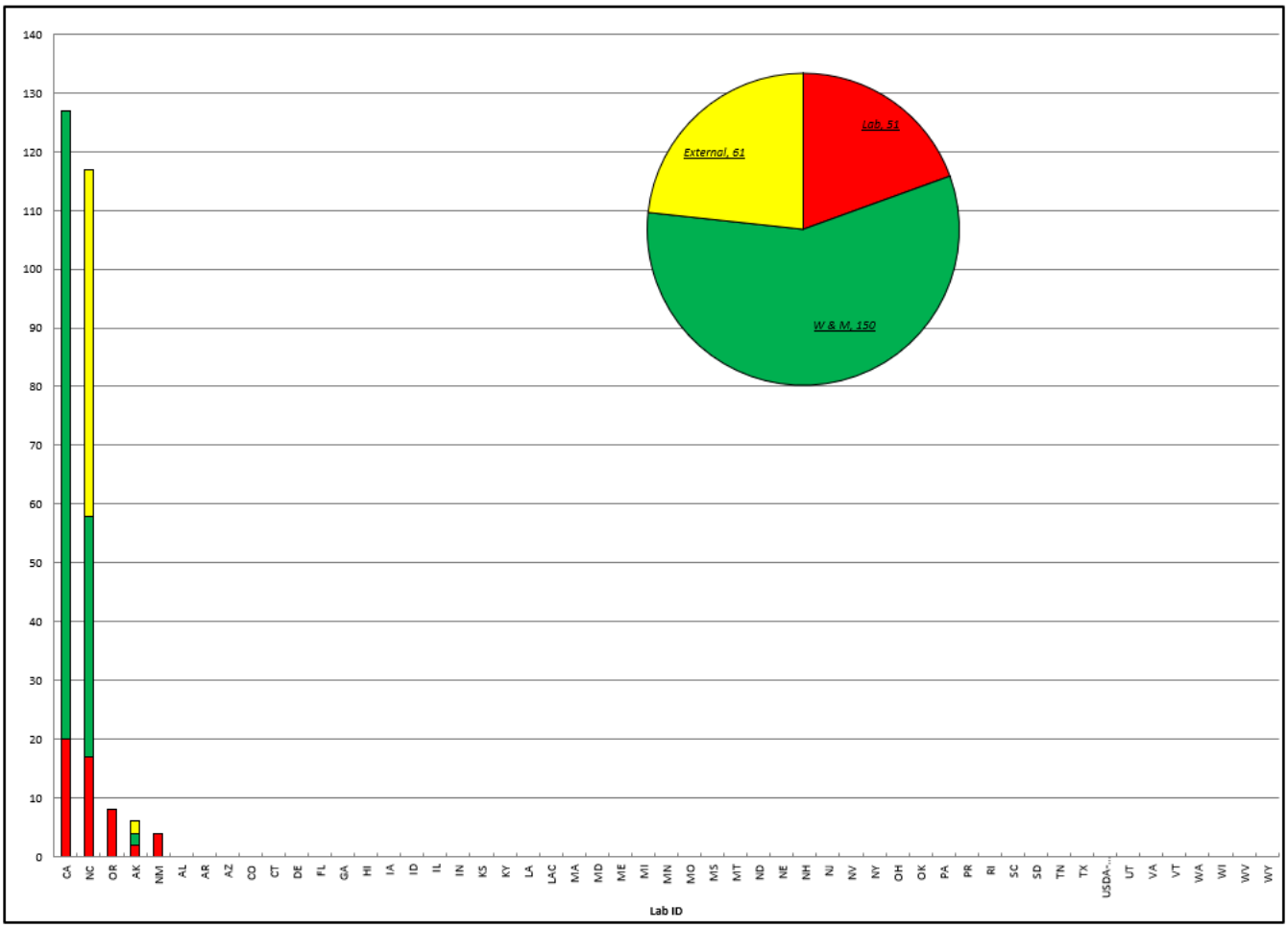


Figure 23: Timing device tests

Wheel Load Weighers

Description

The graphs on the next page represent the total number of measurements performed on wheel load weighers by the 44 reporting laboratories. Each map graph illustrates the geographical distribution of these measurements. The pie graphs located on each map for each individual lab and a larger pie graph that reflects the totals. The bar graph at the bottom of the page shows the same customer breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

Of the 44 reporting laboratories, 15 labs tested a total of 5,934 wheel load weighers.

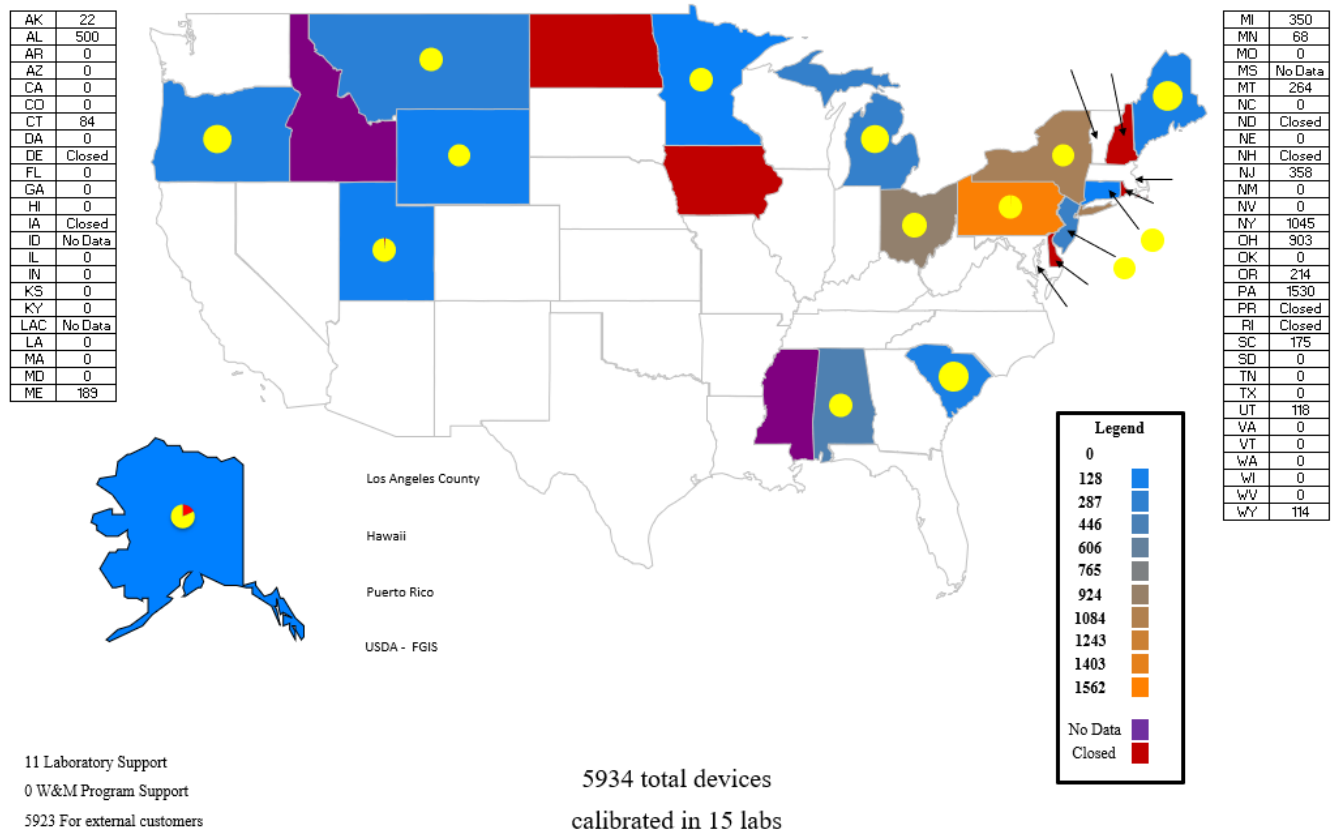
Comparison of previous surveys

Year	# Labs	Total Devices
1998	19	12,178
1999	20	12,781
2000	22	13,699
2002	23	10,350
2004	21	10,884
2005	19	9,748
2006	20	10,567
2008	22	10,191
2010	20	10,815
2012	17	7,050
2014	16	6,515
2016	14	6,541
2018	15	6,476
2020	15	5,934

Table 26: Wheel load weigher tests from previous surveys

Notes and Comments

- 1 % of all wheel load weighers were tested for internal use by the laboratory.
- 0 % of all wheel load weighers were tested for the weight and measures program.
- 99 % of all wheel load weighers were tested for external customers.



11 Laboratory Support
0 W&M Program Support
5923 For external customers

5934 total devices
calibrated in 15 labs

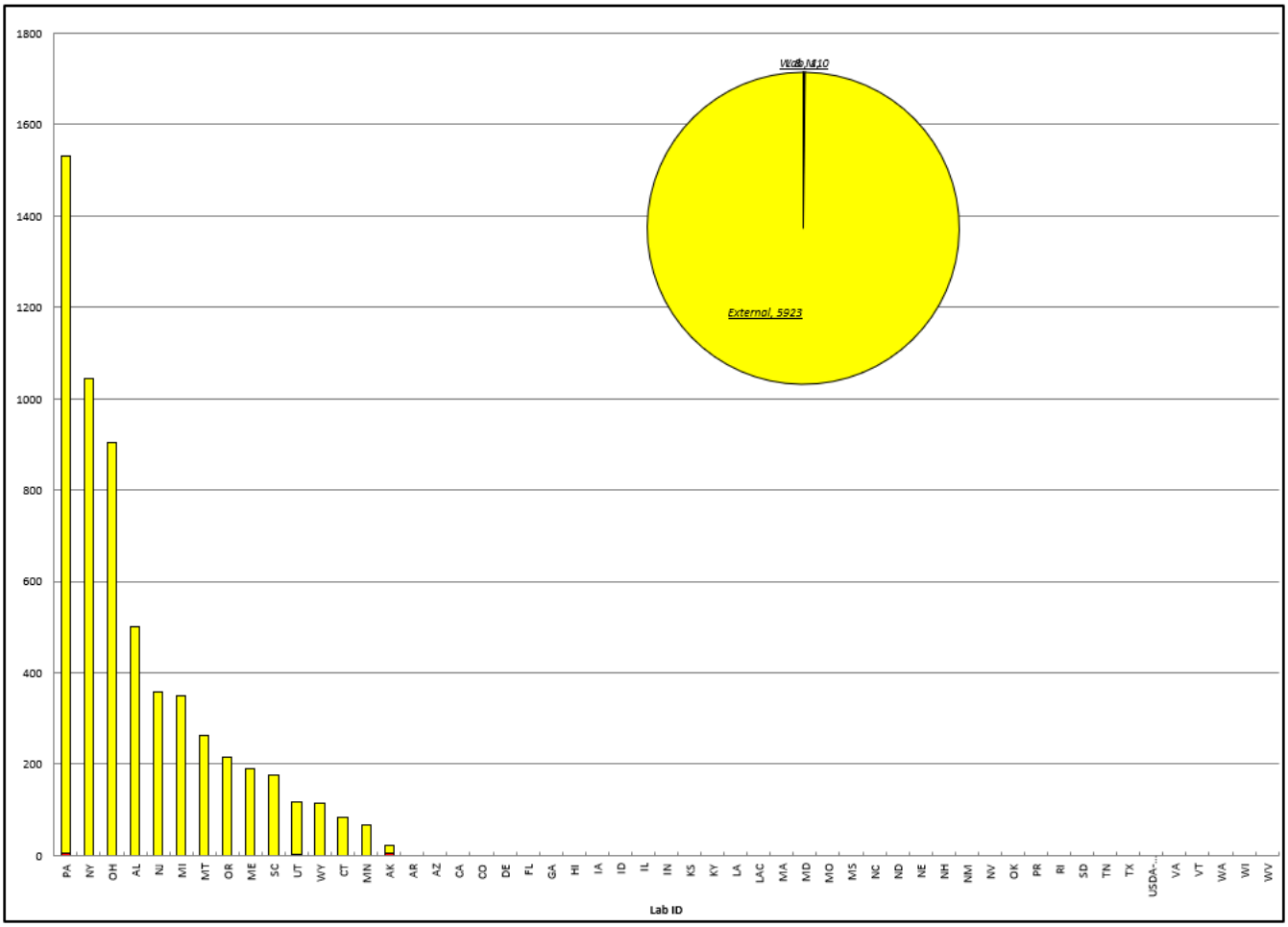


Figure 24: Wheel load weigher tests

Lottery Balls

Description

The graphs on the next page represent the total number of measurements performed on lottery balls by the 44 reporting laboratories. Each map graph illustrates the geographical distribution of these measurements. The pie graphs located on each map for each individual lab and a larger pie graph that reflects the totals. The bar graph at the bottom of the page shows the same customer breakdown along with the total number of devices tested by each laboratory.

- Lab – work done for the internal use of the metrology laboratory.
- W&M – work done for the weights and measures enforcement program.
- External – work done for customers who do not fall into any of the above categories.

Findings

Of the 44 reporting laboratories, 5 labs tested a total of 9,600 lottery balls

Comparison of previous surveys

Year	# Labs	Total Devices
1999	9	19,982
2000	13	24,702
2002	11	35,818
2004	11	40,939
2005	9	47,920
2006	9	41,068
2008	10	42,553
2010	8	46,515
2012	7	13,924[8]
2014	8	40,899
2016	6	80,946[9]
2018	4	11,087[10]
2020	5	9,600

Table 27: Lottery balls tests from previous surveys

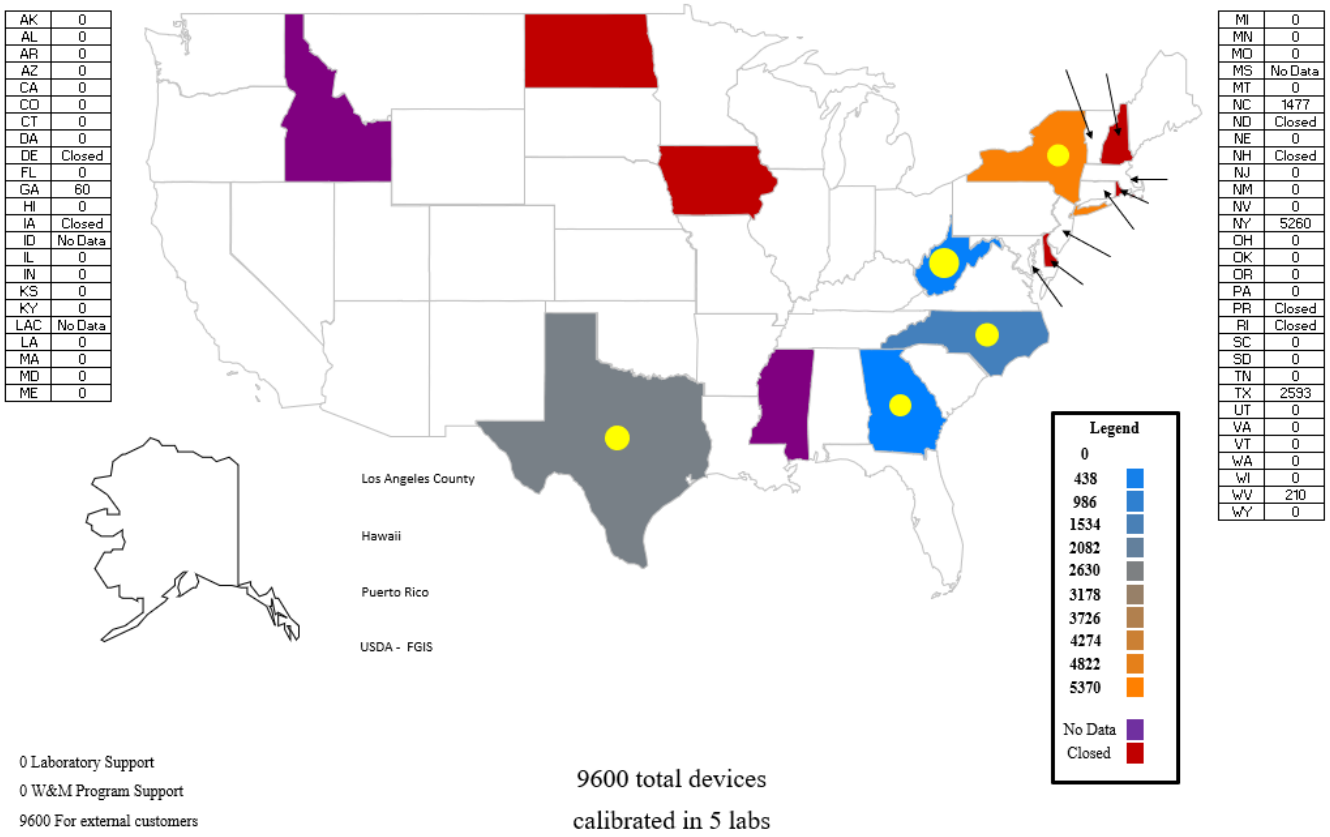
Notes and Comments

- 100 % of all lottery balls were tested for external customers.

[8] The metrology laboratory in Puerto Rico, which normally performs approximately 30,000 of the total number of lottery balls tests, did not submit survey responses in 2012.

[9] The metrology laboratory in Puerto Rico, which performs approximately 30,000 of the total number of lottery balls tests, reported 69,800 in 2016.

[10] The metrology laboratory in Puerto Rico, which normally performs approximately 30,000 of the total number of lottery balls tests, did not submit survey responses in 2018.



0 Laboratory Support
0 W&M Program Support
9600 For external customers

9600 total devices
calibrated in 5 labs

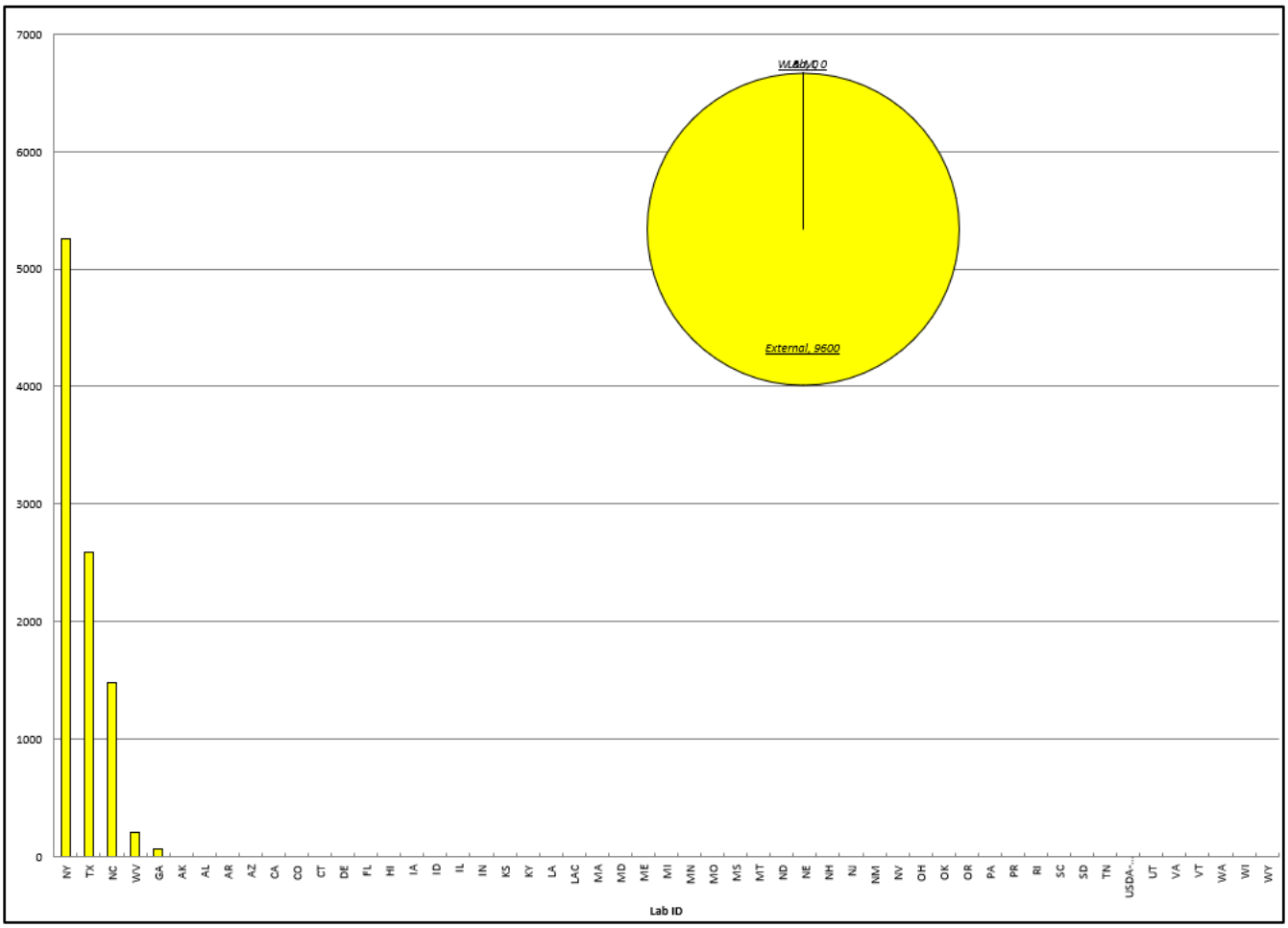


Figure 25 Lottery Ball tests

Summary Other Tests

The category of "Other Tests" is included to give each of the SLP laboratories an opportunity to report calibration work done on devices that did not fit into any of the other categories in the survey. This should not be considered to be an exhaustive list as it was up to each laboratory to determine which tests were worth including in the workload survey and survey allowed for only 3 additional responses per laboratory surveyed.

Test Description	Lab	W&M Program	External	Total
AK Witness testing of Watt Hour Meters	0	0	1	1
CT Scales: Type III scales used by W&M Inspectors and hanging scales used in fishing tournaments)	0	2	1	3
NC Special Test - Control Load Cell & Vaisala to Vaisala comparison	11	0	0	11
NC Special Test - Load Cells for our Highway Patrol Division	0	0	8	8
NJ Laser Devices	0	0	57	57
NJ Scales < 1,000 lb capacity	0	10	154	164
NJ Water Meter Bench Provers	0	0	25	25
PA Force Gauges ≤ 50 lbf	1	0	13	14
AK Distance testing LIDAR units for law enforcement	0	0	52	52
CA Electric Energy, watthour standards	0	29	1	30
USDA-GIPSA Testing of vehicle scales	0	0	75	75
USDA-GIPSA Testing of hopper scales	0	0	25	25
USDA-GIPSA Testing of track scales	0	0	5	5
ME shellfish measures	0	0	30	30
TX Neck Scale Plate Calibrations	0	0	90	90
VT Hydrometry	0	0	7459	7459

Table 28: Other tests reported by the participating laboratories

Laboratory Fees

Description

This information is provided as guidance for SLP member laboratories evaluating the fees they charge for measurement services as well as potential clients whom use their services.

The SLP laboratories charge fees for the calibration work they perform; when reviewing the fee estimates in this section consider;

- laboratories may provide an hourly rate and bill real time for all work done,
- laboratories may provide an hourly rate and bill based on the typical time to complete a calibration,
- laboratories may charge a fixed fee for routine calibration work,
- laboratories may charge additional fees for cleaning, repair, adjusting, packaging, etc. which are outside of that which is normally required to prepare measurement standards for calibration.

The time it takes for any one laboratory to calibrate a particular item will vary significantly between laboratories because of differences in the staffing level, staff experience, the facility, the available weight handling equipment, and the available measurement equipment.

Laboratories were asked to quote the typical fee that they would charge for the various routine measurements instead of providing published hourly rates. This provides each lab with a similar set of assumptions when quoting fees for the survey enabling a more meaningful comparison of fee data between the individual SLP laboratories[11].

Additional Notes:

Only those labs responding to this section of the survey are represented. Labs responding with only a flat per hour service fee are not included, nor are any labs that did not respond to the survey, or are currently closed. No effort was made to extrapolate from previous surveys or to estimate calibration times for each requested service.

[11] Actual fees may differ from those indicated for a variety of reasons including but not limited to the number of required adjustments and the general condition of the equipment as delivered to the laboratory.

Fees for Out of State Customers

The fees quoted are based on in-state calibration work. Most of the member labs charge fees based solely on the measurement services provided, however, the following laboratories report charging higher rates for out-of- state customers;

- GA
- KS
- NC
- NV
- OK
- VT
- WY

Details on labs charging higher rates for out-of-state customers may be found in the comments for sections 8-31 published in this report beginning on page 154.

Fees for Local Government Weights and Measures Programs

Labs were asked if they charge local government for the calibration of W&M field test equipment used for regulatory purposes. The following labs indicated that they charge for calibrating city, county, township (political jurisdiction W&M) equipment and standards:

- AK
- AZ
- CA
- CO
- FL
- GA
- KY
- LA
- MD
- ME
- MN
- MO
- NC
- NE
- NM
- NY
- OK
- OR
- TX
- TN
- UT
- VA
- VT
- WA

NOTE: Labs may not charge because they provide the service pro bono or because there is an absence of W&M programs operated at the county, city, or township level in the region.

Fees for in State Registered Service Companies

Labs were asked if they charge for the calibration of field test equipment used by registered placed in service agents where the agent is registered within the lab's jurisdiction. The following labs indicated that they charge for calibrating registered service company equipment and standards:

- AK
- AL
- AR
- AZ
- CA
- CO
- FL
- GA
- HI
- IL
- IN
- KS
- KY
- LA
- MA
- MD
- ME
- MN
- MO
- MT
- NC
- NE
- NJ
- NM
- NV
- NY
- OH
- OK
- OR
- PA
- SC
- SD
- TN
- TX
- UT
- VA
- VT
- WA
- WI
- WY

NOTE: Not all states operate a service agent registration program.

Fees for "in Jurisdiction" Weights and Measures Programs

Labs were asked if they charge for the calibration of W&M field test equipment used by the W&M program within the lab's jurisdiction. Normally this question addresses W&M programs operated at the state government level. The following labs indicated that they charge for calibrating W&M field equipment and standards:

- CO
- IN
- MN
- OK
- SD
- WA

Laboratory Fee Data Presentation

Fee data are plotted as box and whisker charts showing distribution of reported fees into quartiles delineated by boxes, the mean value, and whiskers intended to highlight both the mean and outliers.

Fees are also tabulated in order from highest to lowest. Each fee table includes the fee estimate provided by each responding laboratory, the estimated calibration time, and indicators which are meant to show whether the laboratory figures packing, equipment setup, certificate preparation, and maintenance of statistical controls explicitly as part of the calibration time estimate.

Historical average fees are reported with each section.

Minimum Laboratory Fees

Description

Labs may enforce a minimum charge to cover all the basic costs associated with performing small calibration jobs. Each laboratory was asked if a minimum calibration fee is assessed and the responses are provided in Figure 26 on page 94.

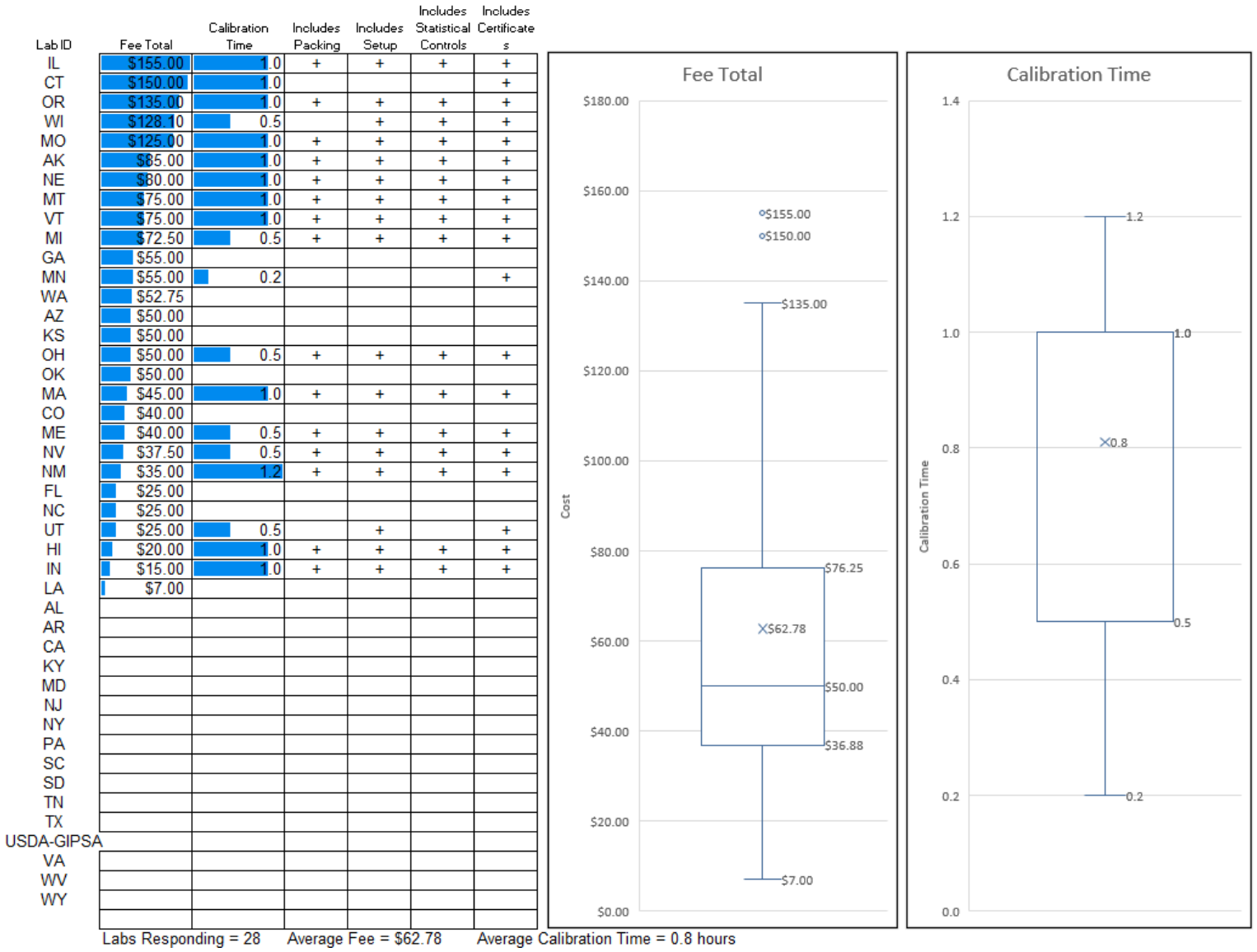


Figure 26: Minimum laboratory fees charged. Calibration time is the minimum calibration time upon which charges are based.

Mass Echelon I

Description

Each laboratory was asked to estimate the fee charged for testing a precision weight kit in good condition containing 21 pieces from 100 g to 1 mg to ASTM Class 0 tolerances using echelon I procedures. Laboratories were not asked to allow for cleaning or adjustments.

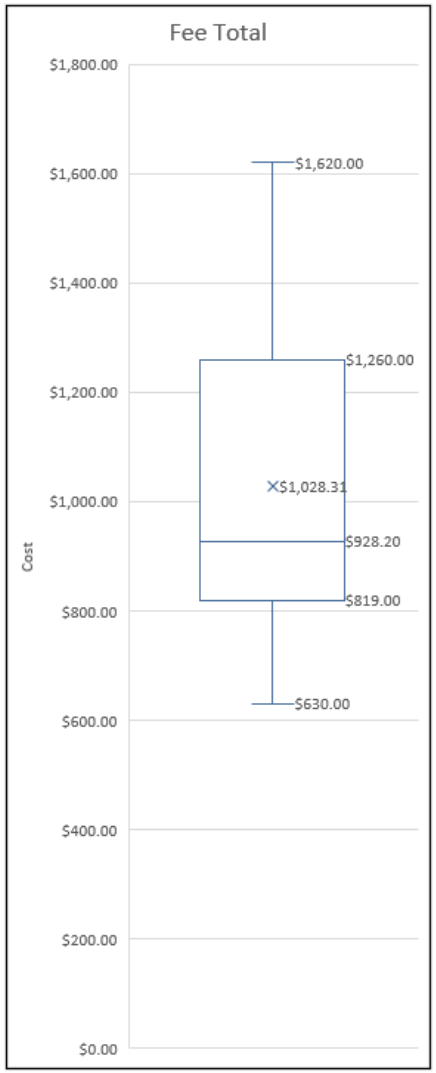
Comparison of Previous Surveys

Survey	Labs Reporting	Average Fee	%Change
2004	15	$617.87	--
2006	16	$758.75	+23 %
2008	14	$700.07	-8 %
2010	15	$780.83	+10 %
2012	14	$820.18	+5 %
2014	15	$870.90	<1 % Change
2016	13	$922.23	+6 %
2018	10	$933.07	+1%
2020	9	$1,028	+10%

Table 29: Average fee charged for echelon I mass testing from 2004 through 2020.

Lab ID	Fee Total	Calibration Time	Includes Packing	Includes Setup	Includes Statistical Controls	Includes Certificates
OR	$1,620.00	12.0	+	+	+	+
MI	$1,522.50	10.5	+	+	+	+
OK	$1,260.00	10.0				
WA	$945.12	9.0	+	+	+	+
MN	$928.20	5.0			+	+
KS	$840.00	6.2	+	+	+	
HI	$819.00	36.0	+	+	+	+
NC	$690.00					
GA	$630.00					
AK						
AL						
AR						
AZ						
CA						
CO						
CT						
FL						
IL						
IN						
KY						
LA						
MA						
MD						
ME						
MO						
MT						
NE						
NJ						
NM						
NV						
NY						
OH						
PA						
SC						
SD						
TN						
TX						
USDA-GIPSA						
UT						
VA						
VT						
WI						
WV						
WY						

Labs Responding = 9 Average Fee = $1028.31 Average Calibration Time = 12.7 hours



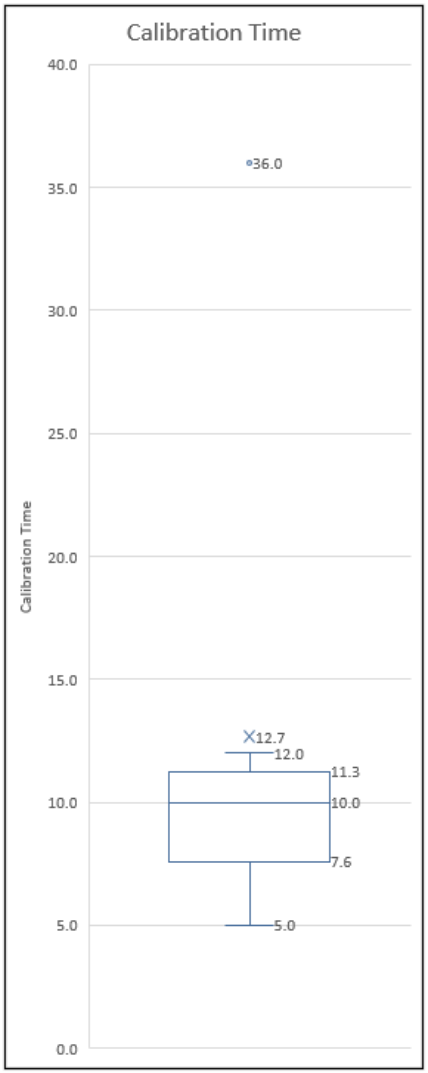


Figure 27: Fees charge for calibrating a precision weight kit containing 21 individual weights ranging from 100 g to 1 mg to ASTM Class 0 tolerances using echelon I testing techniques.

Mass Echelon II

Description

Each laboratory was asked to estimate the fee charged for testing a precision weight kit kit in good condition containing 21 pieces from 100g to 1mg to ASTM Class 2 tolerances using echelon II procedures. Laboratories were not asked to allow for cleaning or adjustments.

Comparison of Previous Surveys

Survey	Labs Reporting	Average Fee	%Change
2000	33	$334.00	--
2002	39	$414.32	+24 %
2004	30	$431.43	+4 %
2006	31	$482.87	+12 %
2008	29	$496.18	+3 %
2010	29	$522.09	+5 %
2012	25	$636.25	+22 %
2014	27	$601.17	< 1 % Change
2016	26	$671.85	+12 %
2018	23	$594.27	-12%
2020	22	$620.09	+4%

Table 30: Average fee charged for echelon II mass testing.

Lab ID	Fee Total	Calibration Time	Includes Packing	Includes Setup	Includes Statistical Controls	Includes Certificates
OR	$1,620.00	12.0	+	+	+	+
CA	$1,200.00	8.0			+	
MI	$913.50	6.3	+	+	+	+
WA	$747.23	7.1	+	+	+	+
MN	$746.20	4.0			+	+
NC	$690.00					
AK	$680.00	8.0	+	+	+	+
GA	$630.00	15.0	+	+	+	
HI	$630.00	22.0	+	+	+	+
PA	$630.00	7.5			+	+
NV	$600.00	8.0	+	+	+	+
VA	$588.00	20.0			+	
OK	$525.00	5.0				+
NM	$504.00	3.0		+	+	+
OH	$500.00	5.0	+	+	+	+
ME	$480.00	6.0	+	+	+	+
NY	$480.00	3.5	+	+	+	+
AZ	$440.00					
FL	$420.00	16.0	+	+	+	+
KS	$420.00	5.4	+	+	+	
CO	$180.00	4.5	+	+	+	+
SC	$18.00	3.5		+	+	+
AL						
AR						
CT						
IL						
IN						
KY						
LA						
MA						
MD						
MO						
MT						
NE						
NJ						
SD						
TN						
TX						
USDA-GIPSA						
UT						
VT						
WI						
WV						
WY						

Labs Responding = 22 Average Fee = $620.09 Average Calibration Time = 8.5 hours

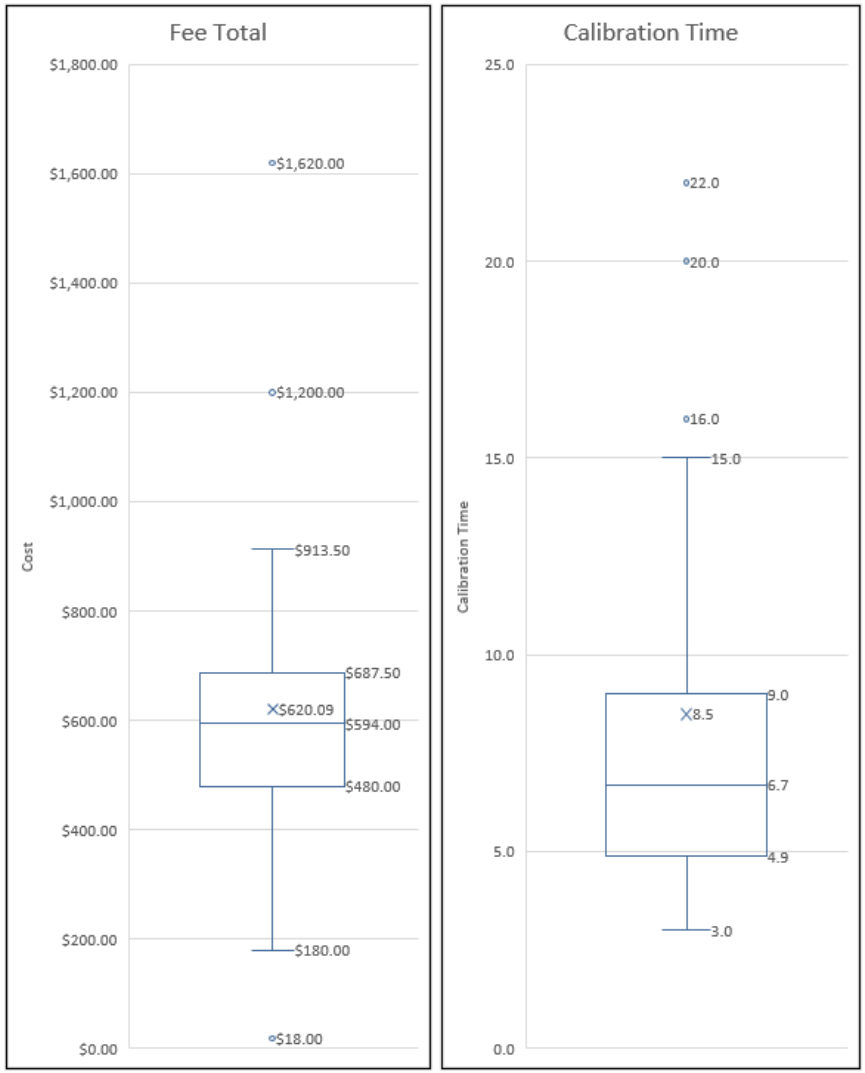


Figure 28: Fees charge for calibrating a precision weight kit containing 21 individual weights ranging from 100 g to 1 mg to ASTM Class 2 tolerances using echelon II testing techniques.

Mass Echelon III (31 lb kits)

Description

Each laboratory was asked to estimate the fee charged for testing a 31 lb weight kit containing 22 pieces to NIST Class F tolerances using echelon III procedures (NIST Handbook 105-1 "Specifications for Field Standard Test Weights (NIST Class F)", 1990). Laboratories were not asked to allow for cleaning or adjustments.

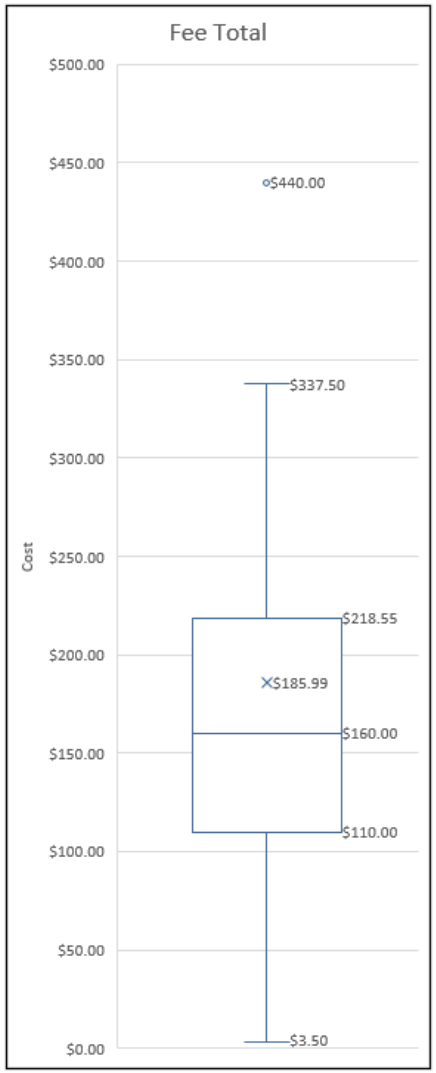
Comparison of Previous Surveys

Survey	Labs Reporting	Average Fee	%Change
2000	36	$77.00	--
2002	41	$94.99	+23 %
2004	38	$121.13	+28 %
2006	42	$135.64	+12 %
2008	44	$156.93	+15 %
2010	41	$179.30	+14 %
2012	43	$186.93	+4 %
2014	46	$187.56	> 1 % change
2016	47	$203.97	> 1 % change
2018	43	$201.28	-1%
2020	43	$185.99	-8%

Table 31: Average fee charged for echelon III mass testing.

Lab ID	Fee Total	Calibration Time	Includes Packing	Includes Setup	Includes Statistical Controls	Includes Certificates
HI	$440.00	12.0	+	+	+	+
NJ	$440.00	1.5			+	
TX	$440.00	1.5	+	+		+
OR	$337.50	2.5	+	+	+	+
WA	$330.90	3.1	+	+	+	+
CA	$330.00	4.4	+	+	+	+
MI	$319.00	2.2	+	+	+	+
IL	$310.00	2.0	+	+	+	+
AK	$300.00	2.0	+	+	+	+
MT	$300.00	4.0	+	+	+	+
NV	$225.00	3.0	+	+	+	+
WI	$212.10	1.5		+	+	
MN	$200.20	1.1			+	+
ME	$200.00	2.5	+	+	+	+
OH	$200.00	2.0	+	+	+	+
UT	$200.00	4.0		+		+
OK	$198.00	1.0		+	+	+
CT	$190.00	1.5				+
AZ	$165.00					
MA	$165.00	3.5	+	+	+	+
TN	$165.00	3.0			+	
NE	$160.00	2.0	+	+	+	+
AR	$154.00	3.0	+	+	+	+
LA	$154.00	1.2	+	+	+	+
VA	$154.00	0.5			+	
FL	$142.00	2.0	+	+	+	+
NM	$132.00	1.0		+	+	+
PA	$132.00	2.0			+	+
MD	$130.00	24.0		+	+	+
MO	$125.00	1.0	+	+	+	+
GA	$121.00	1.5	+	+	+	
AL	$110.00	2.0				
KY	$110.00	3.0		+		
NC	$110.00					
WV	$110.00	1.0	+	+	+	+
CO	$104.00	2.6	+	+	+	+
SD	$96.00	1.0	+	+		+
NY	$92.50	1.5	+	+	+	+
VT	$75.00	1.0	+	+	+	+
WY	$50.00	2.5	+	+	+	+
KS	$35.00	1.5	+	+	+	
IN	$30.00	2.5	+	+	+	+
SC	$3.50	0.5		+	+	+
USDA-GIPSA						

Labs Responding = 43 Average Fee = $185.99 Average Calibration Time = 2.8 hours



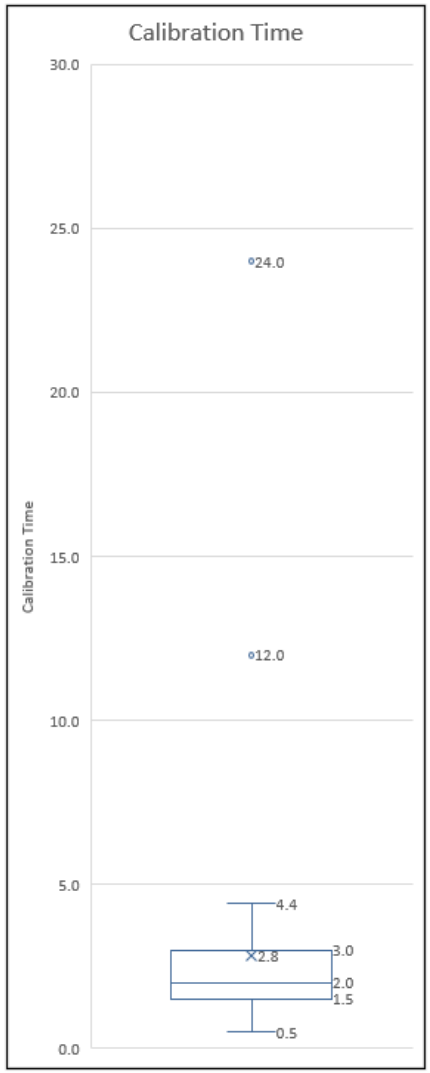


Figure 29: Fees charged for testing a 31 lb weight kit containing 22 pieces to NIST HB 105-1 Class F tolerances using mass echelon III procedures.

Mass Echelon III (50 lb Test Weights)

Description

Each laboratory was asked to estimate the fee charged for testing a set of 20 50 lb cast iron pipe-handle style test weights to NIST Class F tolerances or ASTM E617 Classes 4 – 7 using echelon III procedures (NIST Handbook 105-1 "Specifications for Field Standard Test Weights (NIST Class F)", 1990). Each lab was asked to provide an estimate assuming that 5 of the weights were adjusted.

Comparison of Previous Surveys

Survey	Labs Reporting	Average Fee	%Change
2014	47	$294.67	--
2016	47	$351.98	+19 %
2018	44	$336.72	-4%
2020	43	$365.41	+9%

Table 32: Average fee charged for testing 20 50 lb cast iron pipe-handle test weights.

Lab ID	Fee Total	Calibration Time	Includes Packing	Includes Setup	Includes Statistical Controls	Includes Certificates
TX	$1,550.00	2.0	+	+		+
AK	$1,000.00	4.0	+	+	+	+
NJ	$800.00	2.5			+	
NM	$720.00	3.5		+	+	+
CA	$600.00	4.0	+	+	+	+
HI	$580.00	18.0	+	+	+	+
IL	$465.00	3.0	+	+	+	+
OK	$450.00	1.5		+	+	+
KY	$425.00	2.0		+		
WI	$419.30	1.3		+	+	
WA	$416.51	4.0	+	+	+	+
OR	$405.00	3.0	+	+	+	+
NV	$375.00	5.0	+	+	+	+
MI	$362.50	2.5	+	+	+	+
AR	$360.00	3.0	+	+	+	+
MA	$350.00	5.0	+	+	+	+
NY	$345.00	3.0	+	+	+	+
AZ	$330.00					
TN	$325.00	1.0			+	
CT	$300.00	2.0				+
WV	$300.00	1.5	+		+	+
WY	$300.00	1.5	+	+	+	+
MD	$280.00	24.0		+	+	+
ME	$280.00	3.5	+	+	+	+
MN	$273.00	1.5			+	+
GA	$250.00	3.0	+	+	+	
LA	$250.00	2.8			+	+
NC	$250.00					
OH	$250.00	2.5	+	+	+	+
PA	$250.00	1.0			+	+
FL	$240.00	6.0	+	+	+	+
VA	$240.00	2.0		+	+	
MT	$225.00	3.0	+	+	+	+
CO	$212.00	5.3	+	+	+	+
NE	$210.00	2.0			+	+
UT	$200.00	4.0		+		+
SD	$192.00	2.0	+	+	+	+
VT	$190.00	2.0	+	+	+	+
MO	$187.50	1.5	+	+	+	+
AL	$160.00	6.0				
IN	$160.00	4.5	+	+	+	+
SC	$130.00	2.5		+	+	+
KS	$105.00	3.0	+	+	+	
USDA-GIPSA						

Labs Responding = 43 Average Fee = $365.41 Average Calibration Time = 3.8 hours

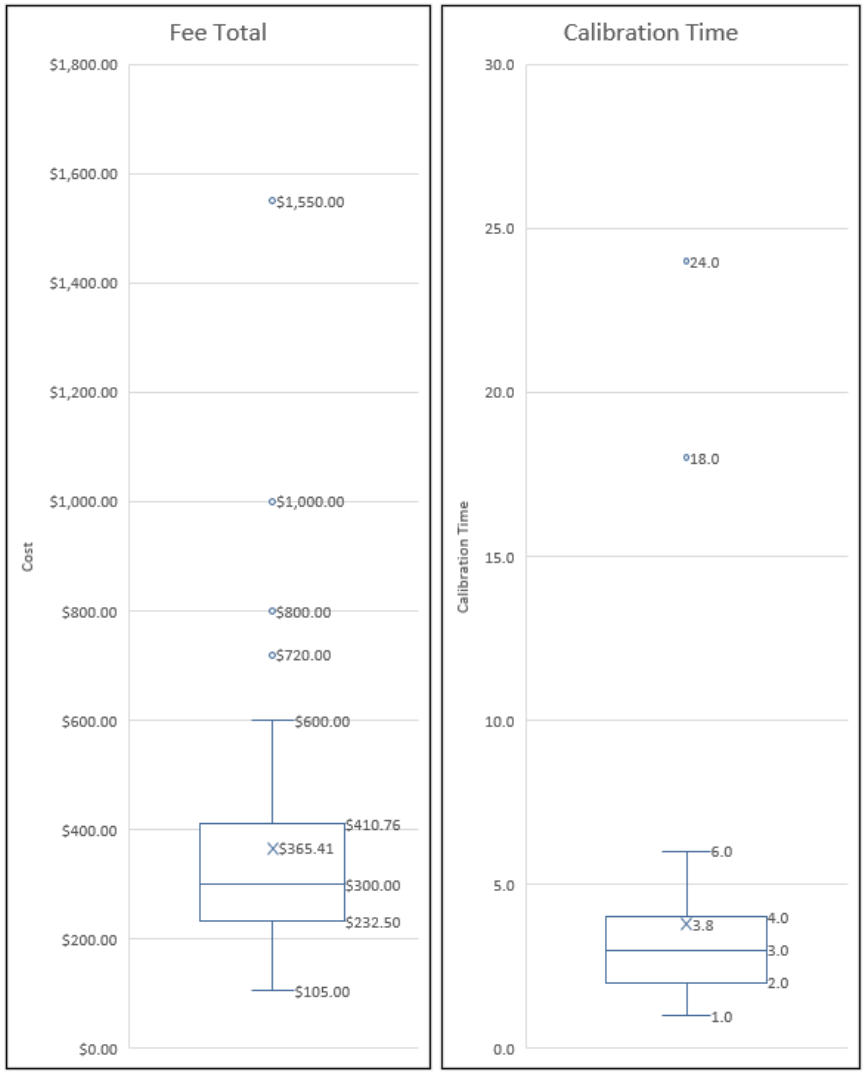


Figure 30: Fees charged for testing a set of 20 50 lb cast iron pipe-handle style test weights to NIST HB 105-1 Class F tolerances using mass echelon III procedures. 5 Adjustments were assumed.

Mass Echelon III (1000 lb Test Weights)

Description

Each laboratory was asked to estimate the fee charged for testing a set of 24 1,000 lb cast iron test weights according to NIST Class F or ASTM E617 Classes 4 – 7 tolerances using echelon III procedures (NIST Handbook 105-1 "Specifications for Field Standard Test Weights (NIST Class F)", 1990). Each lab was asked to provide an estimate assuming that 5 of the weights were adjusted.

Comparison of Previous Surveys

Survey	Labs Reporting	Average Fee	%Change
2014	46	$1,058.00	--
2016	47	$820.06	-22 %
2018	44	$857.66	5%
2020	43	$798.32	-7%

Table 33: Average fee charged for testing 24 1,000 lb cast iron test weights.

Lab ID	Fee Total	Calibration Time	Includes Packing	Includes Setup	Includes Statistical Controls	Includes Certificates
AK	$1,800.00	6.0	+	+	+	+
CA	$1,800.00	8.0		+	+	
NM	$1,728.00	6.0		+	+	+
TX	$1,540.00	4.0	+	+		+
HI	$1,416.00	28.0	+	+	+	+
KY	$1,300.00	4.0		+		
MD	$1,200.00					
OR	$1,080.00	8.0	+	+	+	+
MN	$1,073.80	5.9			+	+
SD	$1,056.00	11.0	+	+	+	+
WI	$982.80	4.0		+	+	
NJ	$960.00	5.0			+	
NY	$960.00	11.0	+	+	+	+
MI	$942.50	6.5	+	+	+	+
IL	$930.00	6.0	+	+	+	+
WA	$911.68	8.6	+	+	+	+
WV	$820.00	2.5	+		+	+
NV	$750.00	10.0	+	+	+	+
OK	$748.00	4.5		+	+	+
VA	$748.00	4.0		+	+	
FL	$720.00	6.0	+	+	+	+
LA	$650.00	4.3			+	+
NE	$644.00	3.0			+	+
AR	$612.00	8.0	+	+	+	+
CT	$600.00	4.0				+
WY	$600.00	5.0	+	+	+	+
NC	$580.00					
OH	$580.00	5.8	+	+	+	+
PA	$580.00	3.0			+	+
VT	$570.00	6.0	+	+	+	+
ME	$560.00	7.0	+	+	+	+
MA	$540.00	6hrs/2men=1	+	+	+	+
UT	$500.00	10.0	+	+		+
IN	$480.00	10.0	+	+	+	+
CO	$468.00	11.7	+	+	+	+
MT	$450.00	6.0	+	+	+	+
GA	$396.00	4.0	+	+	+	
TN	$385.00	4.0			+	
SC	$384.00	3.5		+	+	+
MO	$375.00	3.0	+	+	+	+
AL	$360.00	8.0				
AZ	$330.00					
KS	$217.00	4.5	+	+	+	
USDA-GIPSA						

Labs Responding = 43 Average Fee = $798.32 Average Calibration Time = 6.7 hours

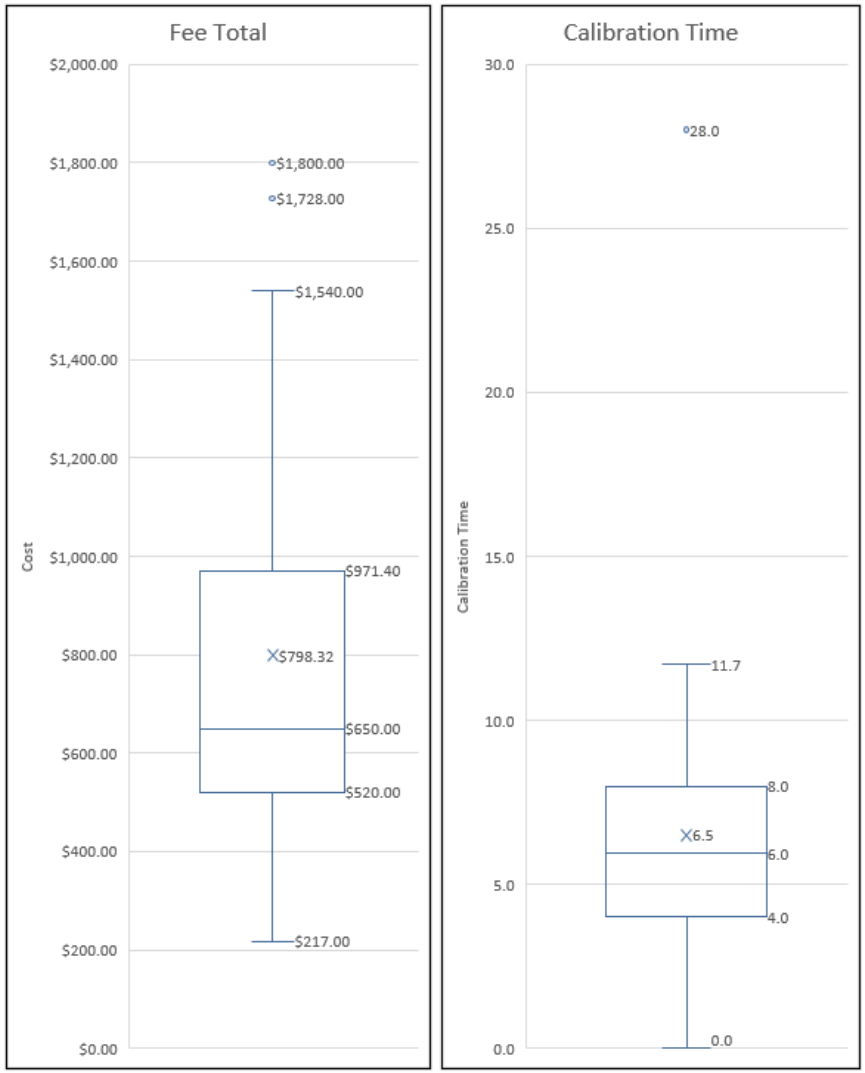


Figure 31: Fees charged for testing a set of 24 1,000 lb cast iron test weights to NIST HB 105-1 Class F tolerances using mass echelon III procedures. 5 Adjustments were assumed.

5,000 lb Weight Cart

Description

Each laboratory was asked to estimate the fee charged for testing a 5,000 lb weight cart according to NIST HB 105-8 tolerances using echelon III procedures (NIST Handbook 105-8 "Specifications and Tolerances for Field Standard Weight Carts", 2019). Laboratories were not asked to allow for cleaning or adjustments.

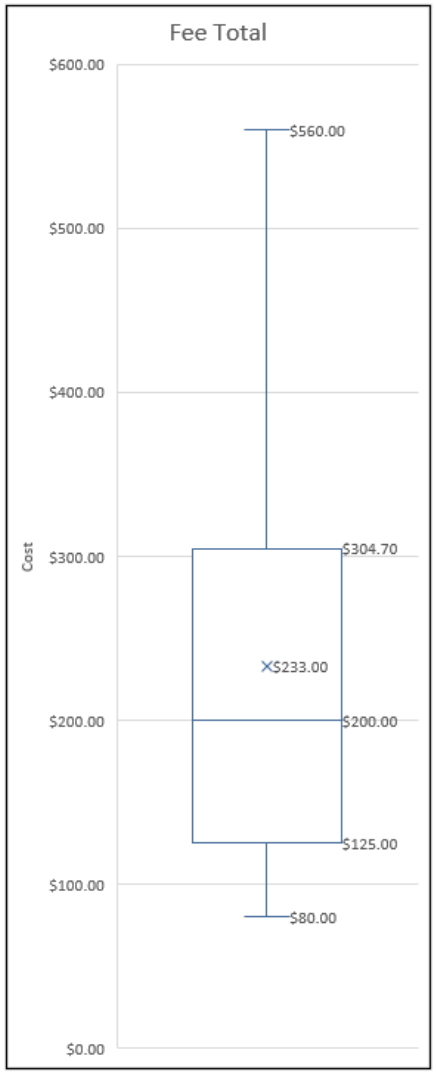
Comparison of Previous Surveys

Survey	Labs Reporting	Average Fee	% Change
2004	28	$163.27	--
2006	31	$205.74	+23 %
2008	31	$185.80	+28 %
2010	34	$225.09	+21 %
2012	30	$201.65	-10 %
2014	31	$203.97	+1 %
2016	32	$205.01	< 1 % Change
2018	31	$208.60	2%
2020	31	$233.00	+12%

Table 34: Average fee charged for a 5,000 lb weight cart testing.

Lab ID	Fee Total	Calibration Time	Includes Packing	Includes Setup	Includes Statistical Controls	Includes Certificates
ME	$560.00	7.0	+	+	+	+
WI	$513.10	2.0		+	+	
AK	$510.00	6.0	+	+	+	+
WA	$443.36	4.2	+	+	+	+
MI	$406.00	2.8	+	+	+	+
MO	$375.00	3.0	+	+	+	+
IL	$310.00	2.0	+	+	+	+
MN	$309.40	1.7			+	+
VT	$300.00	3.0	+	+	+	+
OR	$270.00	2.0	+	+	+	+
NY	$255.00	8.0	+	+	+	+
OK	$250.00	3.0		+	+	+
IN	$200.00	3.0	+	+	+	+
NE	$200.00	2.5	+	+	+	+
OH	$200.00	2.0	+	+	+	+
WV	$200.00	1.0	+		+	+
SC	$195.00	3.0		+	+	+
PA	$180.00	1.5			+	+
MT	$150.00	2.0	+	+	+	+
NM	$145.00	1.0		+	+	+
MD	$140.00					
VA	$131.00	1.0		+	+	
NC	$125.00					
SD	$125.00	1.3	+	+	+	+
CO	$120.00	30.0	+	+	+	+
AZ	$110.00					
GA	$110.00	2.5	+	+	+	
TX	$110.00	2.5	+	+		+
FL	$100.00	2.0	+	+	+	+
WY	$100.00	1.5	+	+	+	+
KS	$80.00	1.5	+	+	+	
AL						
AR						
CA						
CT						
HI						
KY						
LA						
MA						
NJ						
NV						
TN						
USDA-GIPSA						
UT						

Labs Responding = 31 Average Fee = $233 Average Calibration Time = 3.7 hours



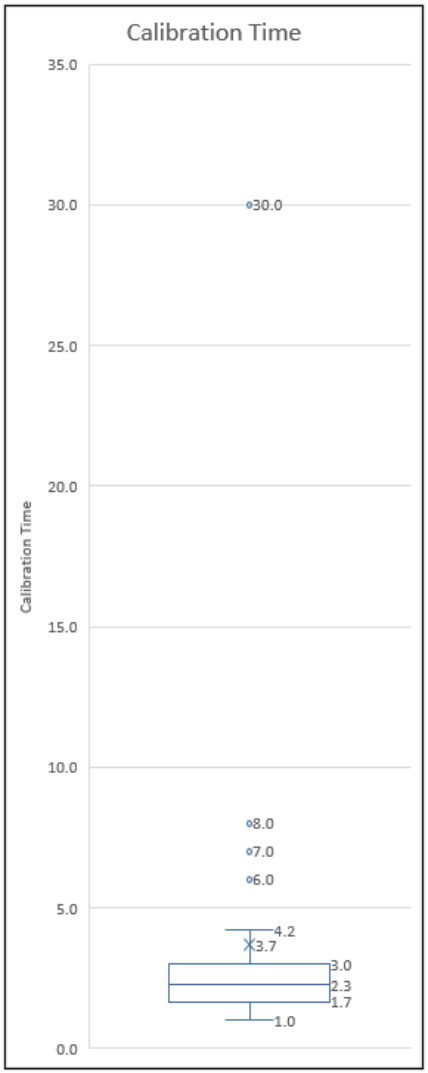


Figure 32: Fees charged for testing a 5,000 lb weight cart according to NIST HB 105-8 tolerances using mass echelon III procedures.

Scale Truck Calibration Class F

Description

Each laboratory was asked to estimate the fee charged for testing the measurement equipment contained in a single scale truck. The truck was assumed to carry 24 1,000 lb cast cube weights requiring 5 adjustments, 20 50 lb pipe-handle weights requiring 5 adjustments, and 2 31 lb weight kits containing 22 pieces each. Echelon III mass calibration procedures were requested for all measurements.

Comparison of Previous Surveys

Survey	Labs Reporting	Average Fee	% Change
2004	39	$1,050.56	--
2006	43	$1,060.77	+23 %
2008	42	$1,300.30	+28 %
2010	44	$1,455.69	+12 %
2012	42	$1,520.41	+4 %
2014	45	$1,472.13	-3 %
2016	47	$1,529.57	+4 %
2018	44	$1562.19	2%
2020	43	$1521.59	-3%

Table 35: Average fee charged for typical scale truck testing.

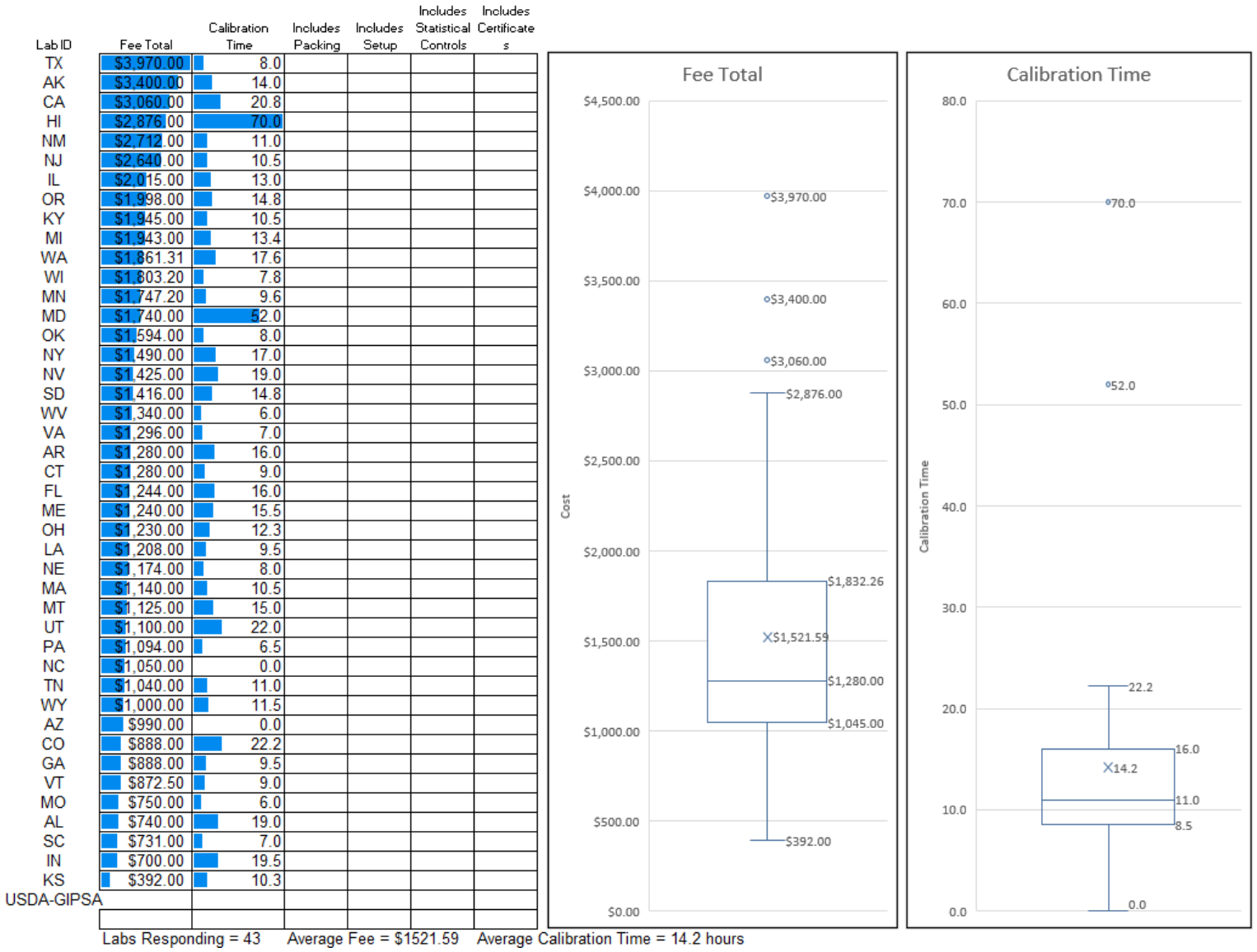


Figure 33: Fees charged for testing a typical scale truck according to mass echelon III procedures.

Length 100 ft Steel Tape

Description

Each laboratory was asked to estimate the fee charged for 19 point testing of a 100 ft tape. Measurement points were requested at 1 ft intervals up to and including 10 ft then at 10 ft intervals up to and including 100 ft. It was left up to each lab to decide how best to test the steel tape, only the fee charged is reported here.

Comparison of Previous Surveys

Survey	Labs Reporting	Average Fee	%Change
2000	33	$133.00	--
2002	36	$173.03	+30 %
2004	22	$250.89	+45 %
2006	22	$261.23	+4 %
2008	18	$244.86	-6 %
2010	16	$234.16	-4 %
2012	10	$246.00	+5 %
2014	9	$198.56	-19 %
2016	7	$200.71	+1 %
2018	5	$195.50	-3%
2020	6	$262.92	+34%

Table 36: Average fee charged for typical 19 point testing of a 100 ft steel tape.

Lab ID	Fee Total	Calibration Time	Includes Packing	Includes Setup	Includes Statistical Controls	Includes Certificates
CA	$600.00	4.0	+	+	+	
OH	$350.00	3.5	+	+	+	+
PA	$285.00	6.0	+	+	+	+
NJ	$140.00	6.0			+	
NY	$102.50	2.0	+	+	+	+
GA	$100.00					
AK						
AL						
AR						
AZ						
CO						
CT						
FL						
HI						
IL						
IN						
KS						
KY						
LA						
MA						
MD						
ME						
MI						
MN						
MO						
MT						
NC						
NE						
NM						
NV						
OK						
OR						
SC						
SD						
TN						
TX						
USDA-GIPSA						
UT						
VA						
VT						
WA						
WI						
WV						
WY						

Labs Responding = 6 Average Fee = $262.92 Average Calibration Time = 4.3 hours

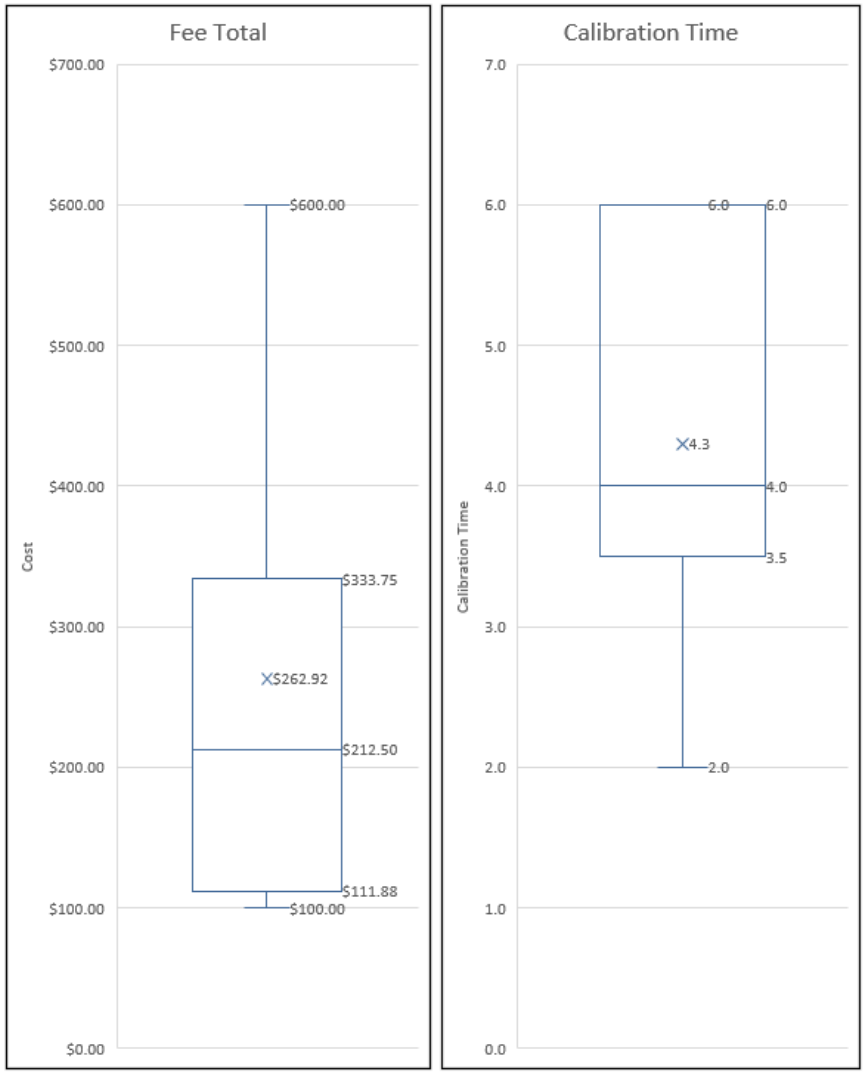


Figure 34: Fees charged for testing a steel 100 ft tape.

5 gallon test measures – Volume Transfer

Description

Each laboratory was asked to estimate the fee charged for testing a single 5 gallon field test measure according to NIST HB 105-3 (NIST Handbook 105-3, "Specifications and Tolerance Graduated Neck Type Volumetric Field Standards", 2010) tolerances using a volume transfer calibration.

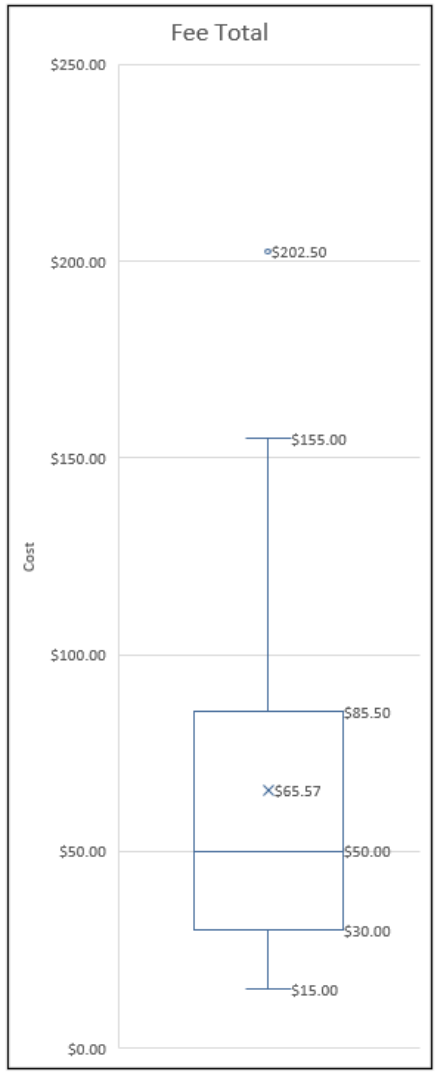
Comparison of Previous Surveys

Survey	Labs Reporting	Average Fee	% Change
2000	35	$35.00	--
2002	41	$41.46	+18 %
2004	39	$42.06	+1 %
2006	43	$43.93	+4 %
2008	43	$56.89	+30 %
2010	44	$64.44	+13 %
2012	44	$63.61	-1 %
2014	46	$62.52	-2 %
2016	48	$67.07	+7 %
2018	44	$70.24	5%
	43	$65.57	-7%

Table 37: Average fee charged for testing of a 5 gallon field test measure via volume transfer.

Lab ID	Fee Total	Calibration Time	Includes Packing	Includes Setup	Includes Statistical Controls	Includes Certificates
OR	$202.50	1.5	+	+	+	+
IL	$155.00	1.0	+	+	+	+
CA	$150.00	0.5			+	
NV	$150.00	2.0	+	+	+	+
WA	$141.79	1.3	+	+	+	+
WI	$128.10	1.0		+	+	
MO	$125.00	1.0	+	+	+	+
MI	$101.50	0.7	+	+	+	+
OH	$100.00	1.0	+	+	+	+
HI	$92.00	5.0	+	+	+	+
MN	$91.00	0.5			+	+
ME	$80.00	1.0	+	+	+	+
AK	$75.00	1.0	+	+	+	+
CT	$75.00	0.5				+
MT	$75.00	1.0	+	+	+	+
SD	$72.00	0.8				+
OK	$60.00	1.0		+	+	+
TX	$55.00	0.8	+	+		+
NE	$51.00	1.0			+	+
AZ	$50.00					
IN	$50.00	1.0	+	+	+	+
KS	$50.00	0.8	+	+	+	
UT	$50.00	1.0	+	+		+
MA	$45.00	1.0	+	+	+	+
PA	$45.00	1.0		+	+	+
VT	$45.00	0.5	+	+		+
AR	$40.00	1.5	+	+	+	+
CO	$40.00	1.0	+	+	+	+
FL	$35.00	2.5	+	+	+	+
NM	$35.00	0.8		+	+	+
SC	$35.00	0.4	+	+	+	+
AL	$30.00					
GA	$30.00	1.0	+	+	+	
LA	$30.00	1.5	+	+	+	+
MD	$30.00	24.0		+	+	+
NC	$30.00					
NJ	$30.00	0.8			+	
WV	$30.00	0.8	+	+	+	+
KY	$25.00	0.5				+
WY	$25.00	1.0	+	+	+	+
NY	$22.50	0.5	+	+	+	+
VA	$22.00	1.0		+	+	
TN	$15.00	0.5	+	+	+	
USDA-GIPSA						

Labs Responding = 43 Average Fee = $65.57 Average Calibration Time = 1.6 hours



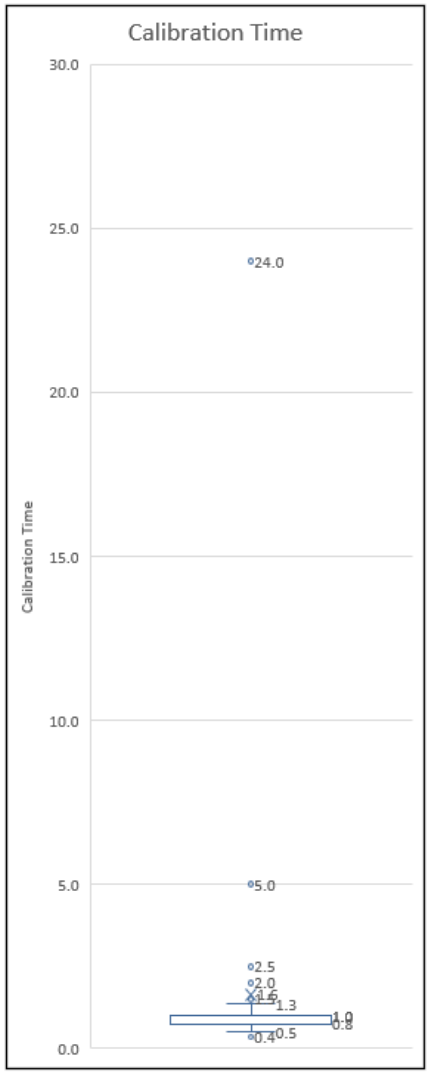


Figure 35: Fees charged for testing a 5 gallon test measure via volume transfer technique.

5 gallon test measure – Gravimetric

Description

Each laboratory was asked to estimate the fee charged for testing a single 5 gallon field standard test measure according to NIST HB 105-3 tolerances (NIST Handbook 105-3, "Specifications and Tolerance Graduated Neck Type Volumetric Field Standards", 2010) using a gravimetric measurement technique.

Comparison of Previous Surveys

Survey	Labs Reporting	Average Fee	% Change
2006	20	$177.95	--
2008	17	$173.65	+23 %
2010	21	$209.25	+21 %
2012	18	$215.24	+3 %
2014	22	$200.95	-7 %
2016	19	$241.26	+20 %
2018	18	$218.05	-10%
2020	16	$216.62	-1%

Table 38: Average fee charged for testing of a 5 gallon field test measure via gravimetric method.

Lab ID	Fee Total	Calibration Time	Includes Packing	Includes Setup	Includes Statistical Controls	Includes Certificates
AZ	$440.00					
WA	$378.48	3.6	+	+	+	+
MN	$364.00	2.0			+	+
NV	$300.00	4.0	+	+	+	+
HI	$276.00	10.0	+	+	+	+
OR	$270.00	2.0	+	+	+	+
AK	$255.00	3.0	+	+	+	+
MI	$217.50	1.5	+	+	+	+
OK	$200.00	3.0		+	+	+
KS	$180.00	2.5	+	+	+	
PA	$180.00	7.5	+	+	+	+
ME	$160.00	2.0	+	+	+	+
SC	$67.50	0.3				
NY	$62.50	1.5	+	+	+	+
NC	$60.00					
GA	$55.00					
AL						
AR						
CA						
CO						
CT						
FL						
IL						
IN						
KY						
LA						
MA						
MD						
MO						
MT						
NE						
NJ						
NM						
OH						
SD						
TN						
TX						
USDA-GIPSA						
UT						
VA						
VT						
WI						
WV						
WY						
	Labs Responding = 16		Average Fee = $216.62		Average Calibration Time = 3.3 hours	

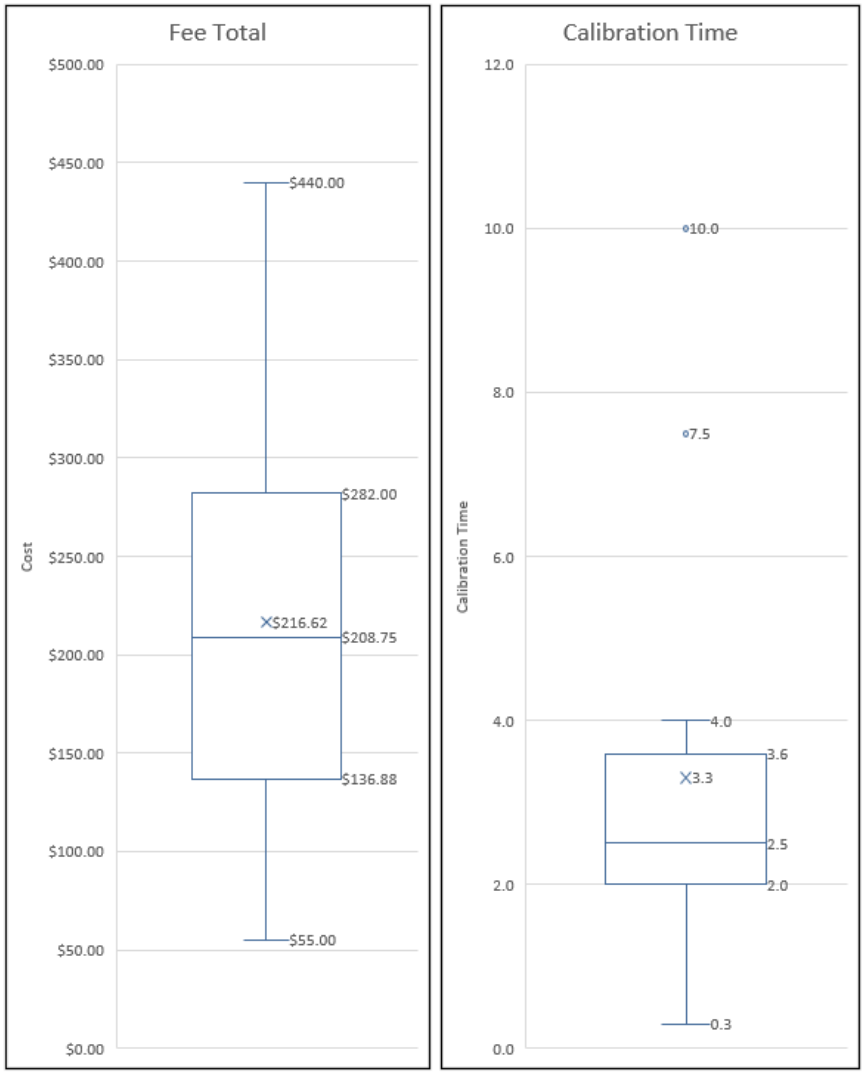


Figure 36 Fees charged for gravimetrically testing a 5 gallon field test measure.

100 gallon field standard prover – Volume Transfer

Description

Each laboratory was asked to estimate the fee charged for testing a 100 gallon field standard prover according to NIST HB 105-3 tolerances (NIST Handbook 105-3, "Specifications and Tolerance Graduated Neck Type Volumetric Field Standards", 2010) using a volume transfer calibration technique.

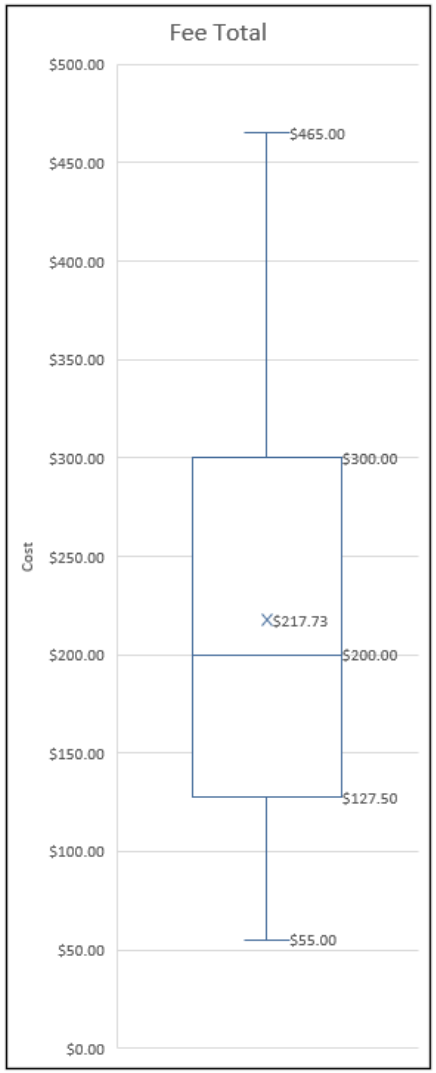
Comparison of Previous Surveys

Survey	Labs Reporting	Average Fee	% Change
2000	35	$108.00	--
2002	40	$125.19	+16 %
2004	35	$138.73	+11 %
2006	37	$145.32	+5 %
2008	36	$191.83	+32 %
2010	38	$219.76	+15 %
2012	38	$206.35	-6 %
2014	40	$217.01	+5 %
2016	42	$224.16	+3 %
2018	38	$214.57	-4%
2020	39	$217.73	1%

Table 39: Average fee charged for testing of a 100 gallon field standard prover via volume transfer.

Lab ID	Fee Total	Calibration Time	Includes Packing	Includes Setup	Includes Statistical Controls	Includes Certificates
IL	$465.00	3.0	+	+	+	+
CA	$450.00	0.5			+	
OR	$391.50	2.9	+	+	+	+
MO	$375.00	3.0	+	+	+	+
HI	$368.00	12.0	+	+	+	+
MI	$362.50	2.5	+	+	+	+
MA	$360.00	4hrs/2men=8	+	+	+	+
WA	$342.29	3.2	+	+	+	+
CT	$300.00	2.0				+
MT	$300.00	4.0	+	+	+	+
NV	$300.00	4.0	+	+	+	+
VT	$300.00	3.0	+	+		+
OH	$250.00	2.5	+	+	+	+
OK	$250.00	3.0		+	+	+
WI	$247.10	3.0		+	+	
ME	$240.00	3.0	+	+	+	+
AZ	$220.00					
MN	$218.40	1.2			+	+
AK	$200.00	2.0	+	+	+	+
NJ	$200.00	1.5			+	
WV	$200.00	1.0	+	+	+	+
WY	$200.00	2.0	+	+	+	+
NE	$160.00	2.0	+	+	+	+
TX	$160.00	2.0	+	+		+
NM	$150.00	2.5	+	+	+	+
PA	$150.00	2.5	+	+	+	+
TN	$150.00	2.0			+	
UT	$150.00	3.0	+	+		+
SC	$135.00	1.5	+	+	+	+
CO	$120.00	3.0	+	+	+	+
MD	$110.00					
FL	$106.25	3.0	+	+	+	+
IN	$100.00	3.0	+	+	+	+
NY	$97.50	5.0	+	+	+	+
KS	$85.00	1.3	+	+	+	
KY	$80.00	3.0		+		+
AL	$75.00					
NC	$68.00					
GA	$55.00	2.0	+	+	+	
AR						
LA						
SD						
USDA-GIPSA						
VA						

Labs Responding = 39 Average Fee = $217.73 Average Calibration Time = 2.8 hours



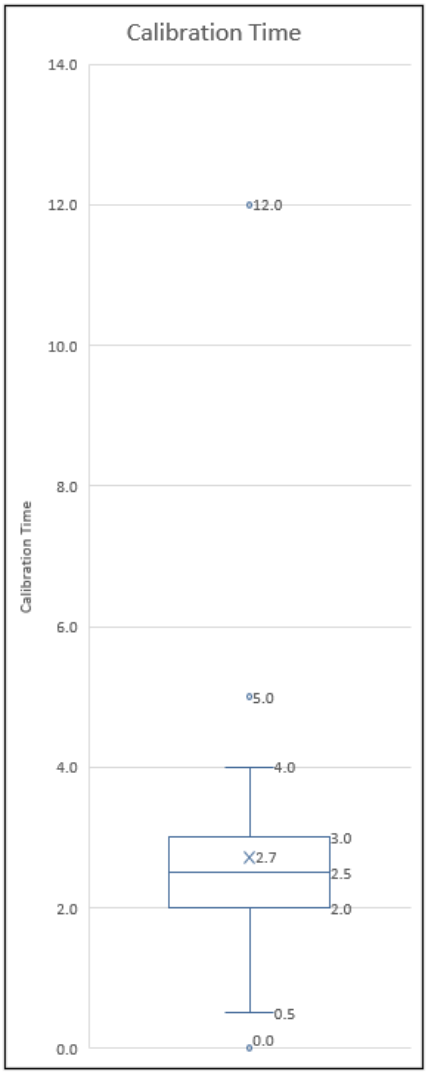


Figure 37: Fees charged for testing a 100 gallon field standard prover via volume transfer technique.

100 gallon field standard prover- Gravimetric

Description

Each laboratory was asked to estimate the fee charged for testing a 100 gallon field standard prover according to NIST HB 105-3 tolerances (NIST Handbook 105-3, "Specifications and Tolerance Graduated Neck Type Volumetric Field Standards", 2010) using a gravimetric calibration technique.

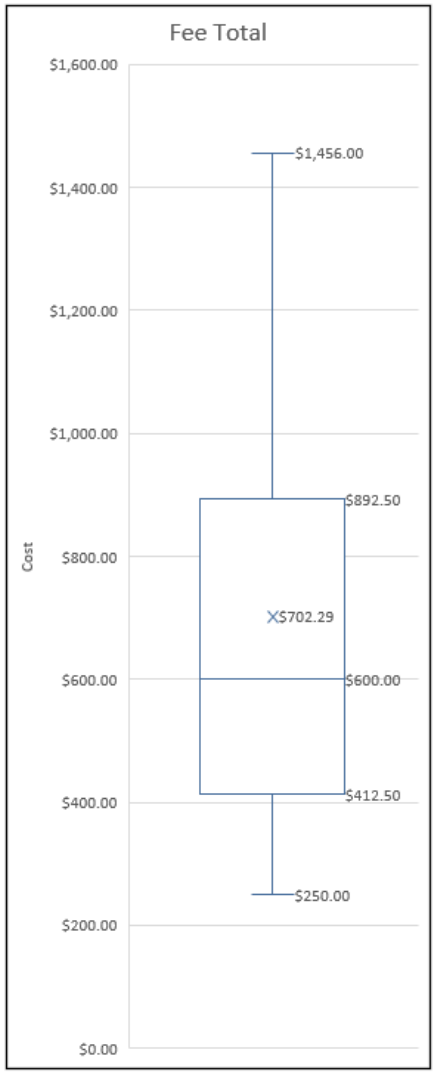
Comparison of Previous Surveys

Survey	Labs Reporting	Average Fee	% Change
2006	4	$265.00	+5 %
2008	7	$434.29	+64 %
2010	7	$597.14	+37 %
2012	7	$447.14	-25 %
2014	8	$670.63	+50 %
2016	7	$854.29	+27 %
2018	7	$702.29	-18%
2020	7	$702.29	0%

Table 40: Average fee charged for testing of a 100 gallon field test standard prover via gravimetric method.

Lab ID	Fee Total	Calibration Time	Includes Packing	Includes Setup	Includes Statistical Controls	Includes Certificates
MN	$1,456.00	6.0			+	+
PA	$1,125.00	15.0	+	+	+	+
AZ	$660.00					
OK	$600.00	7.0		+	+	+
ME	$480.00	6.0	+	+	+	+
NY	$345.00	8.0	+	+	+	+
NC	$250.00					
AK						
AL						
AR						
CA						
CO						
CT						
FL						
GA						
HI						
IL						
IN						
KS						
KY						
LA						
MA						
MD						
MI						
MO						
MT						
NE						
NJ						
NM						
NV						
OH						
OR						
SC						
SD						
TN						
TX						
USDA-GIPSA						
UT						
VA						
VT						
WA						
WI						
WV						
WY						

Labs Responding = 7 Average Fee = $702.29 Average Calibration Time = 8.4 hours



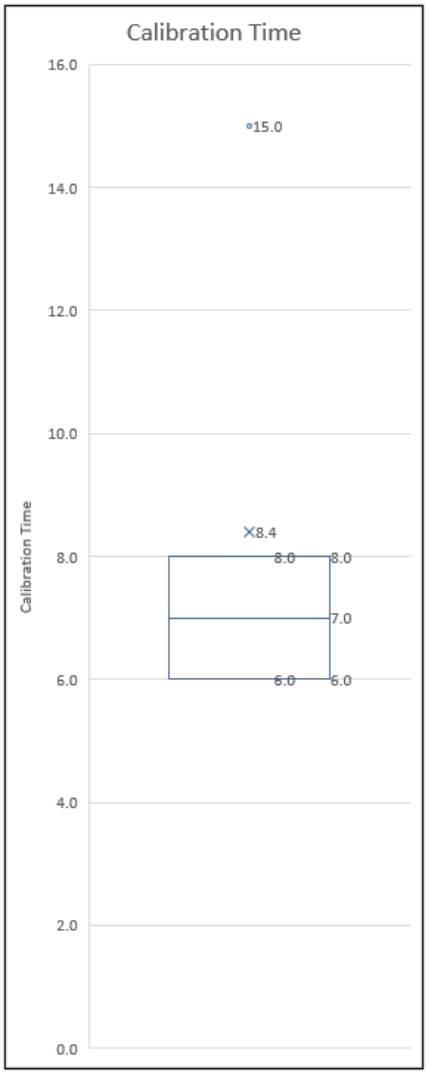


Figure 38: Fees charged for gravimetrically testing a 100 gallon field standard steel prover.

100 gallon field standard prover LPG – Volume Transfer

Description

Each laboratory was asked to estimate the fee charged for testing a 100 gallon liquefied petroleum gas (LPG) field standard prover according to NIST HB 105-4 tolerances (NIST Handbook 105-4, "Specifications and Tolerances for Liquified Petroleum Gas and Anhydrous Ammonia Liquid Volumetric Provers", 2016) using a volume transfer calibration technique.

Comparison of Previous Surveys

Survey	Labs Reporting	Average Fee	%Change
2006	32	$255.78	--
2008	31	$295.39	+23 %
2010	38	$219.75	-26 %
2012	29	$348.05	+58 %
2014	31	$347.05	< 1 % change
2016	30	$372.44	+7 %
2018	29	$389.74	5%
2020	28	$394.65	1%

Table 41: Average fees charged for the testing of a 100 gallon LPG prover from via volume transfer.

Lab ID	Fee Total	Calibration Time	Includes Packing	Includes Setup	Includes Statistical Controls	Includes Certificates
OR	$823.50	6.1	+	+	+	+
CA	$750.00	3.5			+	
MN	$728.00	4.0			+	+
WI	$618.10	4.0		+	+	
WA	$602.62	5.7	+	+	+	+
MT	$600.00	8.0	+	+	+	+
OH	$600.00	6.0	+	+	+	+
MI	$580.00	4.0	+	+	+	+
WV	$500.00	5.0	+	+	+	+
ME	$480.00	6.0	+	+	+	+
IL	$465.00	3.0	+	+	+	+
NV	$450.00	6.0	+	+	+	+
AZ	$440.00					
AK	$400.00	4.0	+	+	+	+
MO	$375.00	3.0	+	+	+	+
NY	$370.00	7.0	+	+	+	+
TX	$325.00	3.5	+	+		+
NM	$250.00	3.0	+	+	+	+
NE	$240.00	3.0	+	+	+	+
FL	$200.00	8.0	+	+	+	+
NJ	$200.00	2.0			+	
WY	$200.00	3.0	+	+	+	+
SC	$195.00	3.0	+	+	+	+
KS	$170.00	1.8	+	+	+	
CO	$160.00	4.0	+	+	+	+
GA	$135.00	3.0	+	+	+	
IN	$125.00	3.5	+	+	+	+
NC	$68.00					
AL						
AR						
CT						
HI						
KY						
LA						
MA						
MD						
OK						
PA						
SD						
TN						
USDA-GIPSA						
UT						
VA						
VT						

Labs Responding = 28 Average Fee = $394.65 Average Calibration Time = 4.4 hours

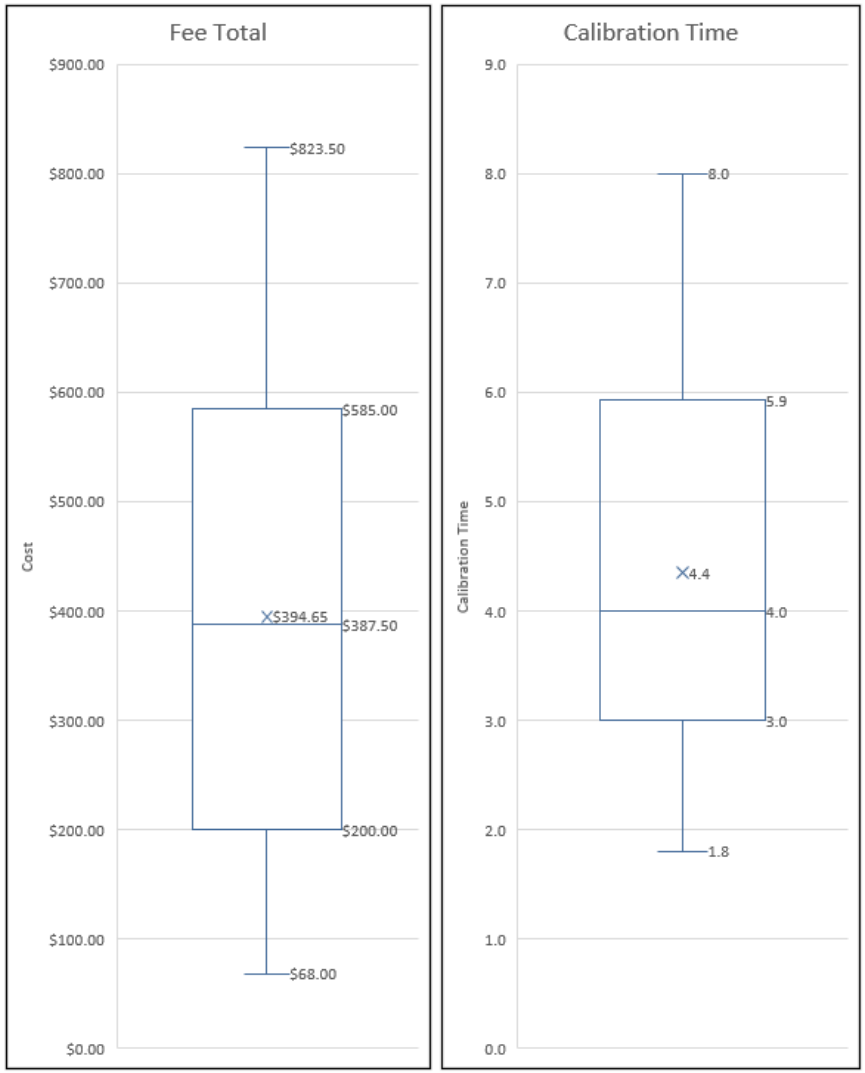


Figure 39: Fees charged for testing a 100 gallon LPG prover.

20 Gallon Dynamic Small Volume Prover (SVP) – Volume Transfer

Description

In previous surveys each lab was asked to estimate the fee for calibrating a 20 gallon SVP according to NIST HB 105- 7 tolerances (NIST Handbook 105-7, "Specifications and Tolerances for Dynamic Small Volume Provers", 1997). The question was deprecated in 2016 because only a very few labs calibrate these devices. The results are reprinted in this survey for convenient reference.

Comparison of Previous Surveys

Survey	Labs Reporting	Average Fee	% Change
2006	3	$113.33	--
2008	2	$123.75	+9 %
2010	1	$100.00	-19 %
2012	2	$200.00	+100 %
2014	4	$220.00	+10 %

Table 42: Average fee charged for testing a SVP via volume transfer from 2006 through 2014.

Metrology Positions/Title and Salaries

Each laboratory was asked to provide position titles and salary ranges for personnel employed by the lab. They were asked to categorize each position according to the metrology function performed.

Lab ID	Job Title	Standardized Title	Min Salary	Max Salary
AK	State Metrologist II	Laboratory Supervisor	$55,044.00	$93,648.00
AR	Supervison/Quality Manager	Laboratory Supervisor	$50,222.04	$72,822.00
AZ	State Metrologist	Laboratory Supervisor	$46,593.60	$79,424.40
CO	Physical Scientist	Laboratory Supervisor	$94,464.00	$153,084.00
FL	Laboratory Manager	Laboratory Supervisor	$42,813.36	$88,847.16
GA	State Metrologist	Laboratory Supervisor	$39,038.04	$71,523.00
HI	Metrologist 3	Laboratory Supervisor	$55,200.00	$81,744.00
KS	Agricultural Inspector / State Metrologist	Laboratory Supervisor	$46,266.72	$53,206.80
KY	Metrology Lab Supervisor	Laboratory Supervisor	$38,770.08	$63,952.32
LA	Richert W. Williams	Laboratory Supervisor	$67,308.00	$117,936.00
MD	Administrator I	Laboratory Supervisor	$44,016.96	$70,265.04
ME	Metrologist	Laboratory Supervisor	$49,363.20	$67,027.20
MI	Metrologist Manager - 14	Laboratory Supervisor	$63,481.56	$93,392.04
MN	Lab Manager: SPA Manager Senior	Laboratory Supervisor	$76,296.00	$109,766.04
MO	Metrology Lab Manager	Laboratory Supervisor	$38,472.00	$79,440.00
MT	Metrologist	Laboratory Supervisor	$42,474.00	$54,699.60
NC	Laboratory Manager	Laboratory Supervisor	$46,203.00	$78,217.92
NE	State Metrologist	Laboratory Supervisor	$42,000.00	$57,600.00
NJ	Sup. of Licensing, Metrololgy, and Registration	Laboratory Supervisor	$80,001.48	$116,023.20
NM	Regulatory Lab Manager	Laboratory Supervisor	$48,960.00	$73,440.00
NV	Metrologist III	Laboratory Supervisor	$45,643.68	$67,901.76
NY	Specialist II (Lab Manager)	Laboratory Supervisor	$73,284.00	$92,693.04
NY	Director	Laboratory Supervisor	$99,414.96	$125,628.96
OH	Laboratory Supervisor	Laboratory Supervisor	$47,892.00	$60,480.00
OK	Metrologist IV	Laboratory Supervisor	$43,162.68	$79,131.60
OR	Lead Metrologist	Laboratory Supervisor	$72,108.00	$110,724.00
PA	Laboratory Supervisor	Laboratory Supervisor	$58,895.04	$89,448.00
SC	Metrology Lab Director/Manager	Laboratory Supervisor	$48,000.00	$75,000.00
TX	Manager For Metrology Laboratory	Laboratory Supervisor	$51,612.00	$84,480.00
VT	W & M Section Chief and State Metrologist	Laboratory Supervisor	$57,792.00	$90,600.00
WA	State Metrologist	Laboratory Supervisor	$44,652.00	$60,012.00
WI	Laboratory Director (Chemist Supervisor)	Laboratory Supervisor	$44,889.60	$74,092.80
WV	Program Specialist- Head Metrologist	Laboratory Supervisor	$31,140.00	$57,624.00
WY	Inspection Supervisor	Laboratory Supervisor	$59,172.00	$88,764.00
CA	Measurement Standards Specialist III	Metrology/Calibration Engineer	$59,400.00	$74,352.00
CA	Principal State Metrologist	Metrology/Calibration Engineer	$96,276.00	$109,344.00
CO	Physical Scientist II	Metrology/Calibration Engineer	$65,796.00	$96,288.00
CT	Metrologist	Metrology/Calibration Engineer	$58,665.24	$83,187.24
CT	W&M Inspector	Metrology/Calibration Engineer	$65,913.24	$83,239.20
GA	Metrologist	Metrology/Calibration Engineer	$30,000.00	$78,000.00
HI	Metrologist 2	Metrology/Calibration Engineer	$51,024.00	$75,588.00
IN	Metrologist I	Metrology/Calibration Engineer	$45,000.00	$72,000.00
KY	Metrology Lab Technician II	Metrology/Calibration Engineer	$29,129.28	$48,048.00
MI	Metrology Specialist - 13	Metrology/Calibration Engineer	$58,905.60	$86,486.40
MI	Metrologist - 12	Metrology/Calibration Engineer	$54,288.00	$79,143.96
MI	Metrologist - P11	Metrology/Calibration Engineer	$51,708.84	$72,800.04
MI	Metrologist - 10	Metrology/Calibration Engineer	$44,636.76	$62,961.60
MI	Metrologist - 9	Metrology/Calibration Engineer	$43,201.56	$61,630.44

Lab ID	Job Title	Standardized Title	Min Salary	Max Salary
NC	Quality Assurance Manager	Metrology/Calibration Engineer	$36,677.04	$62,091.96
NC	Grain Moisture Program Supervisor	Metrology/Calibration Engineer	$36,677.04	$62,091.96
NM	Metrologist, Intermediate	Metrology/Calibration Engineer	$36,720.00	$55,080.00
NV	Metrologist II	Metrology/Calibration Engineer	$41,843.52	$62,055.36
PA	Metrologist (PSL Basic Requirements)	Metrology/Calibration Engineer	$57,624.00	$78,416.04
PA	Metrologist (PSL Intermediate Requirements)	Metrology/Calibration Engineer	$60,126.96	$78,416.04
SD	State Metrologist	Metrology/Calibration Engineer	$44,223.84	$62,640.00
TN	Metrologist	Metrology/Calibration Engineer	$38,472.00	$61,524.00
TX	Inspector V	Metrology/Calibration Engineer	$36,972.00	$58,392.00
TX	Program Specialist III	Metrology/Calibration Engineer	$42,240.00	$68,952.00
UT	State Metrologist	Metrology/Calibration Engineer	$46,944.00	$74,460.00
VA	State Metrologist	Metrology/Calibration Engineer	$54,000.00	$54,000.00
VT	Consumer Protection Specialist	Metrology/Calibration Engineer	$40,620.00	$80,100.00
AK	State Metrologist II	Metrology/Calibration Technician	$47,784.00	$81,876.00
AR	Metrologist	Metrology/Calibration Technician	$36,155.04	$52,425.00
CA	Laboratory Assistant	Metrology/Calibration Technician	$33,240.00	$44,772.00
CA	Measurement Standards Specialist I	Metrology/Calibration Technician	$41,040.00	$50,604.00
CA	Measurement Standards Specialist II	Metrology/Calibration Technician	$46,956.00	$58,092.00
CO	Physical Scientist Intern	Metrology/Calibration Technician	$52,944.00	$77,508.00
FL	Senior Metrologist	Metrology/Calibration Technician	$31,847.52	$55,310.16
FL	Metrologist	Metrology/Calibration Technician	$27,087.12	$44,530.80
HI	Metrologist 1	Metrology/Calibration Technician	$47,196.00	$69,876.00
IN	Metrologist I	Metrology/Calibration Technician	$39,996.00	$51,996.00
IN	Metrologist I	Metrology/Calibration Technician	$39,996.00	$51,996.00
KS	Agricultural Inspector / Metrologist	Metrology/Calibration Technician	$36,000.00	$41,400.00
KY	Program Coordinator	Metrology/Calibration Technician	$32,042.40	$53,270.40
KY	Metrology Lab Technician I	Metrology/Calibration Technician	$24,072.96	$39,711.84
LA	Whitney Corley	Metrology/Calibration Technician	$39,168.00	$68,640.00
LA	Jennifer Martin	Metrology/Calibration Technician	$39,168.00	$68,640.00
MD	Metrologist I	Metrology/Calibration Technician	$36,557.04	$57,807.96
MD	Metrologist II	Metrology/Calibration Technician	$38,880.00	$61,691.04
MN	Technical Manager/ Lab Administrator: SPA Principal	Metrology/Calibration Technician	$57,540.00	$84,792.00
MN	Metrologist: SPA Senior	Metrology/Calibration Technician	$50,172.00	$73,584.00
MO	Metrology Specialist	Metrology/Calibration Technician	$28,716.00	$62,400.00
NC	Metrologist I	Metrology/Calibration Technician	$33,960.00	$57,492.96
NJ	Weights and Measures Inspector 2	Metrology/Calibration Technician	$61,989.72	$94,936.44
NJ	Weights and Measures Inspector 1	Metrology/Calibration Technician	$53,548.08	$82,023.12
NV	Metrologist I	Metrology/Calibration Technician	$38,440.08	$56,751.84
NY	Specialist I	Metrology/Calibration Technician	$56,604.00	$71,979.96
OH	Weights and Measures Technologist	Metrology/Calibration Technician	$42,240.00	$54,960.00
OK	Metrologist I	Metrology/Calibration Technician	$26,502.12	$48,587.28
OK	Laboratory Technician I	Metrology/Calibration Technician	$21,720.00	$27,585.96
OR	Metrologist	Metrology/Calibration Technician	$65,520.00	$100,716.00
PA	Metrologist	Metrology/Calibration Technician	$55,061.04	$78,416.04
SC	Lab Technologist I	Metrology/Calibration Technician	$27,516.00	$50,928.00
SC	Lab Technologist II	Metrology/Calibration Technician	$33,492.00	$61,968.00
VA	State Metrologist	Metrology/Calibration Technician	$49,704.00	$49,704.00
WI	Metrologist	Metrology/Calibration Technician	$44,889.60	$74,092.80
WV	Labor Inspector II- Asst. Metrologist	Metrology/Calibration Technician	$26,400.00	$48,840.00
WY	Inspection Specialist	Metrology/Calibration Technician	$41,448.00	$62,184.00
AR	Director	Support Staff	$62,531.04	$90,669.96
FL	Laboratory Technician IV	Support Staff	$24,498.96	$42,010.56
KY	Agricultural Inspector I	Support Staff	$21,886.80	$36,102.48

Lab ID	Job Title	Standardized Title	Min Salary	Max Salary
NC	Administrative Associate II	Support Staff	$27,780.00	$44,091.00
NJ	Agency Service Representative 3	Support Staff	$40,079.40	$56,215.44
PA	Laboratory Administrative Assistant	Support Staff	$35,364.00	$52,773.00
TX	Administrative Assistant IV	Support Staff	$32,976.00	$52,044.00
VA	Administer	Support Staff	$17,280.00	$17,280.00
VT	Consumer Protection Specialist	Support Staff	$40,620.00	$80,100.00
WI	Metrologist (LTE)	Support Staff	$34,483.20	$56,870.40
AL	Laboratory Supervisor		$32,287.20	$48,924.00
AL	Consumer W & M Protection Specialist		$28,516.80	$47,757.60
AL	Labor		$9,000.00	$13,500.00
AZ	Assistant State Metrologist		$36,168.00	$67,982.40
IL	Public Service Administrator		$55,344.00	$83,880.00
IL	Metrologist Associate		$45,504.00	$67,212.00
IL	Products & Standards Inspector		$45,408.00	$65,376.00
MA	State Metrologist & Laboratory Manager		$54,000.00	$78,000.00
USDA-GIPSA	Program Manager		$102,180.00	$132,840.00
USDA-GIPSA	Industrial Specialist		$85,932.00	$111,720.00

Table 43: Metrologist position titles and salary ranges.

SLP Metrology Salaries – Standardized Title Comparison

A comparison of salary ranging reported across the SLP is made here using the standardized titled reported for each job title;

- Laboratory Supervisor
- Metrology/Calibration Engineer
- Metrology/Calibration Technician
- Support Staff

Annual salaries for each position identified are plotted on a range from minimum to maximum and sorted on the highest possible compensation from high to low. Summary information for the entire program is provided showing minimum, maximum, and average values for the minimum salaries, maximum salaries, and salary ranges.

No adjustments have been made to these data for cost of living variations across the nation.

Laboratory Supervisor

	Minimum	Maximum	Average
Minimum Salary	$31,140.00	$53,207.00	$42,173.50
Maximum Salary	$99,415.00	$153,084.00	$126,249.50
Salary Range	$68,275.00	$99,877.00	$99,877.00

Metrologist/Calibration Engineer

	Minimum	Maximum	Average
Minimum Salary	$29,129.00	$48,048.00	$35,588.50
Maximum Salary	$96,276.00	$109,344.00	$102,810.00
Salary Range	$67,147.00	$61,296.00	$61,221.50

Metrologist/Calibration Technician

	Minimum	Maximum	Average
Minimum Salary	$21.720.00	$27,586.00	$24,653.00
Maximum Salary	$65,520.00	$100,716.00	$83,118.00
Salary Range	$43,800.00	$73,130.00	$58,465.00

Support Staff

	Minimum	Maximum	Average
Minimum Salary	$17,280.00	$17,280.00	$17,280.00
Maximum Salary	$62,531.00	$90,670.00	$76.600.50
Salary Range	$45,250.00	$73,390.00	$59,320.50

Table 44: SLP metrologist compensation summary by standardized job titles. Calculations are rounded to the dollar.

Laboratory Supervisor

Lab ID	Min Salary	Max Salary
AK	$55,044.00	$93,648.00
AR	$50,222.04	$72,822.00
AZ	$46,593.60	$79,424.40
CO	$94,464.00	$153,084.00
FL	$42,813.36	$88,847.16
GA	$39,038.04	$71,523.00
HI	$55,200.00	$81,744.00
KS	$46,266.72	$53,206.80
KY	$38,770.08	$63,952.32
LA	$67,308.00	$117,936.00
MD	$44,016.96	$70,265.04
ME	$49,363.20	$67,027.20
MI	$63,481.56	$93,392.04
MN	$76,296.00	$109,766.04
MO	$38,472.00	$79,440.00
MT	$42,474.00	$54,699.60
NC	$46,203.00	$78,217.92
NE	$42,000.00	$57,600.00
NJ	$80,001.48	$116,023.20
NM	$48,960.00	$73,440.00
NV	$45,643.68	$67,901.76
NY	$73,284.00	$92,893.04
NY	$99,414.96	$125,628.96
OH	$47,892.00	$60,480.00
OK	$43,162.68	$79,131.60
OR	$72,108.00	$110,724.00
PA	$58,895.04	$89,448.00
SC	$48,000.00	$75,000.00
TX	$51,612.00	$84,480.00
VT	$57,792.00	$90,600.00
WA	$44,652.00	$60,012.00
WI	$44,889.60	$74,092.80
WV	$31,140.00	$57,624.00
WY	$59,172.00	$88,764.00

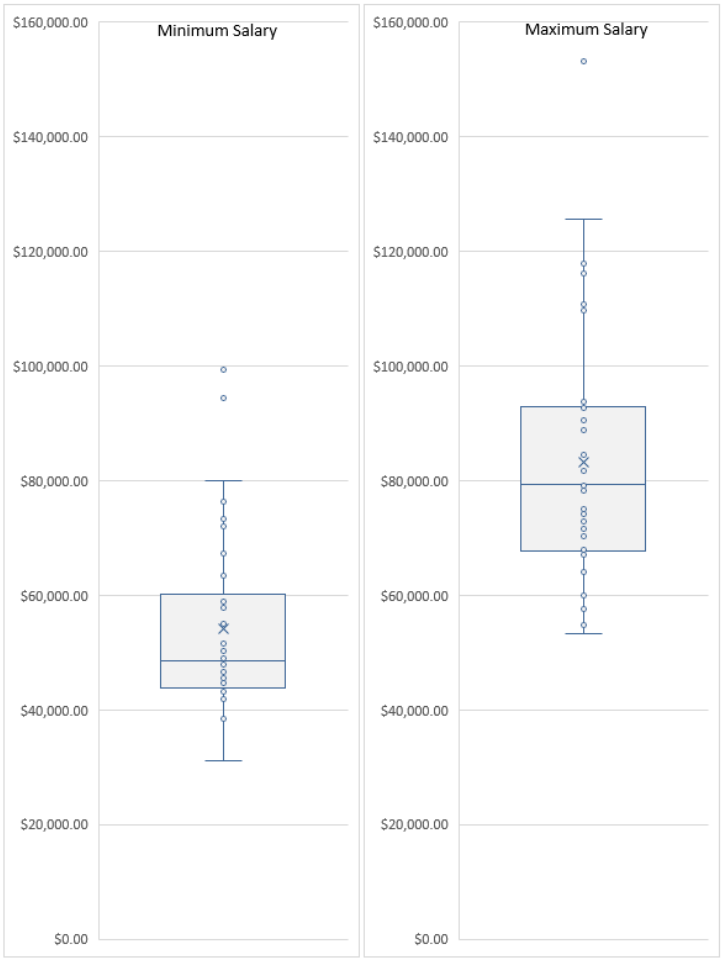


Figure 40: Salaries for Laboratory Supervisors

Metrology/Calibration Engineer

Lab ID	Min Salary	Max Salary
CA	$59,400.00	$74,352.00
CA	$96,276.00	$109,344.00
CO	$65,796.00	$96,288.00
CT	$58,665.24	$83,187.24
CT	$65,913.24	$83,239.20
GA	$30,000.00	$78,000.00
HI	$51,024.00	$75,588.00
IN	$45,000.00	$72,000.00
KY	$29,129.28	$48,048.00
MI	$58,905.60	$86,486.40
MI	$54,288.00	$79,143.96
MI	$51,708.84	$72,800.04
MI	$44,636.76	$62,961.60
MI	$43,201.56	$61,630.44
NC	$36,677.04	$62,091.96
NC	$36,677.04	$62,091.96
NM	$36,720.00	$55,080.00
NV	$41,843.52	$62,055.36
PA	$57,624.00	$78,416.04
PA	$60,126.96	$78,416.04
SD	$44,223.84	$62,640.00
TN	$38,472.00	$61,524.00
TX	$36,972.00	$58,392.00
TX	$42,240.00	$68,952.00
UT	$46,944.00	$74,460.00
VA	$54,000.00	$54,000.00
VT	$40,620.00	$80,100.00

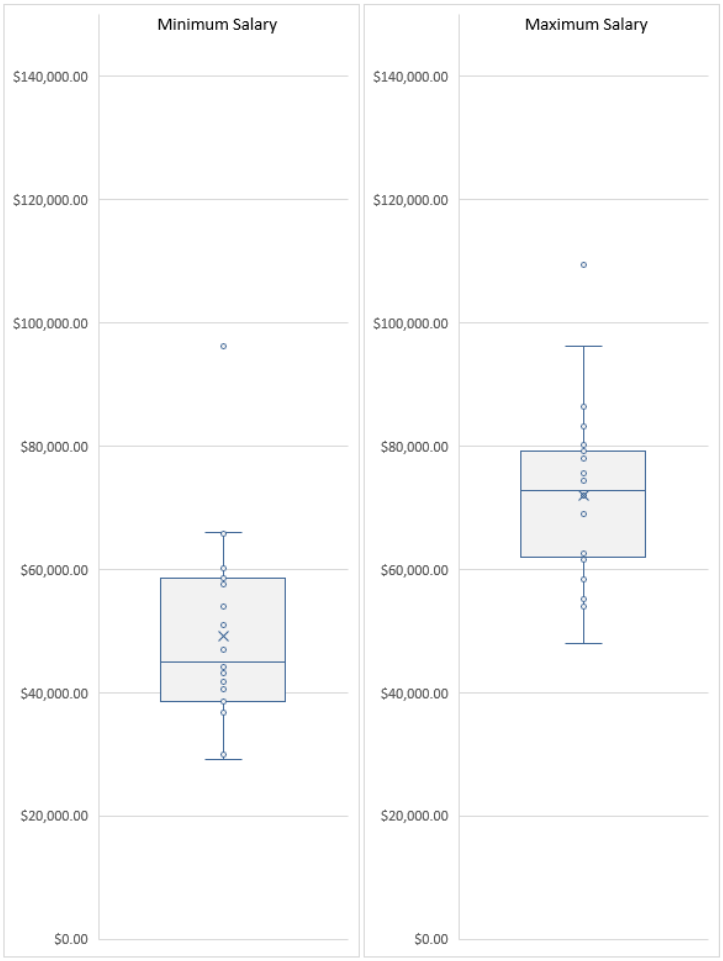


Figure 41: Salary ranges for Metrology/Calibration Engineers

Metrology/Calibration Technician

Lab ID	Min Salary	Max Salary
AK	$47,784.00	$81,876.00
AR	$36,155.04	$52,425.00
CA	$33,240.00	$44,772.00
CA	$41,040.00	$50,604.00
CA	$46,956.00	$58,092.00
CO	$52,944.00	$77,508.00
FL	$31,847.52	$55,310.16
FL	$27,087.12	$44,530.80
HI	$47,196.00	$69,876.00
IN	$39,996.00	$51,996.00
IN	$39,996.00	$51,996.00
KS	$36,000.00	$41,400.00
KY	$32,042.40	$53,270.40
KY	$24,072.96	$39,711.84
LA	$39,168.00	$68,640.00
LA	$39,168.00	$68,640.00
MD	$36,557.04	$57,807.96
MD	$38,880.00	$61,691.04
MN	$57,540.00	$84,792.00
MN	$50,172.00	$73,584.00
MO	$28,716.00	$62,400.00
NC	$33,960.00	$57,492.96
NJ	$61,989.72	$94,936.44
NJ	$53,548.08	$82,023.12
NV	$38,440.08	$56,751.84
NY	$56,604.00	$71,979.96
OH	$42,240.00	$54,960.00
OK	$26,502.12	$48,587.28
OK	$21,720.00	$27,585.96
OR	$65,520.00	$100,716.00
PA	$55,061.04	$78,416.04
SC	$27,516.00	$50,928.00
SC	$33,492.00	$61,968.00
VA	$49,704.00	$49,704.00
WI	$44,889.60	$74,092.80
WV	$26,400.00	$48,840.00
WY	$41,448.00	$62,184.00

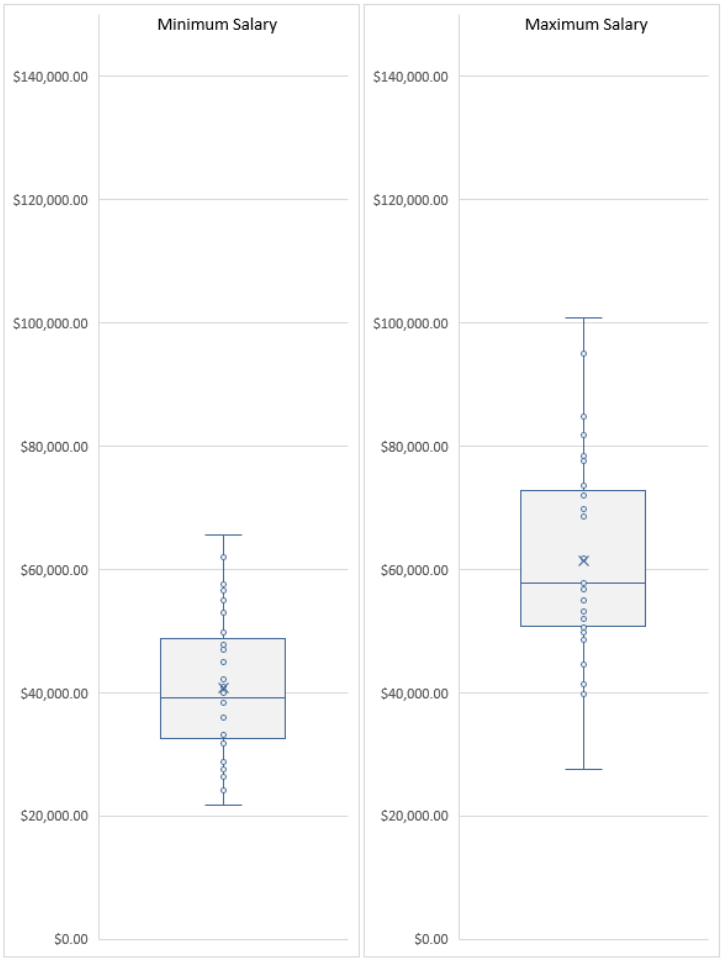


Figure 42: Salary ranges for Metrology/Calibration Technicians

Support Staff

Lab ID	Min Salary	Max Salary
AR	$62,531.04	$90,669.96
FL	$24,498.96	$42,010.56
KY	$21,886.80	$36,102.48
NC	$27,780.00	$44,091.00
NJ	$40,079.40	$56,215.44
PA	$35,364.00	$52,773.00
TX	$32,976.00	$52,044.00
VA	$17,280.00	$17,280.00
VT	$40,620.00	$80,100.00
WI	$34,483.20	$56,870.40

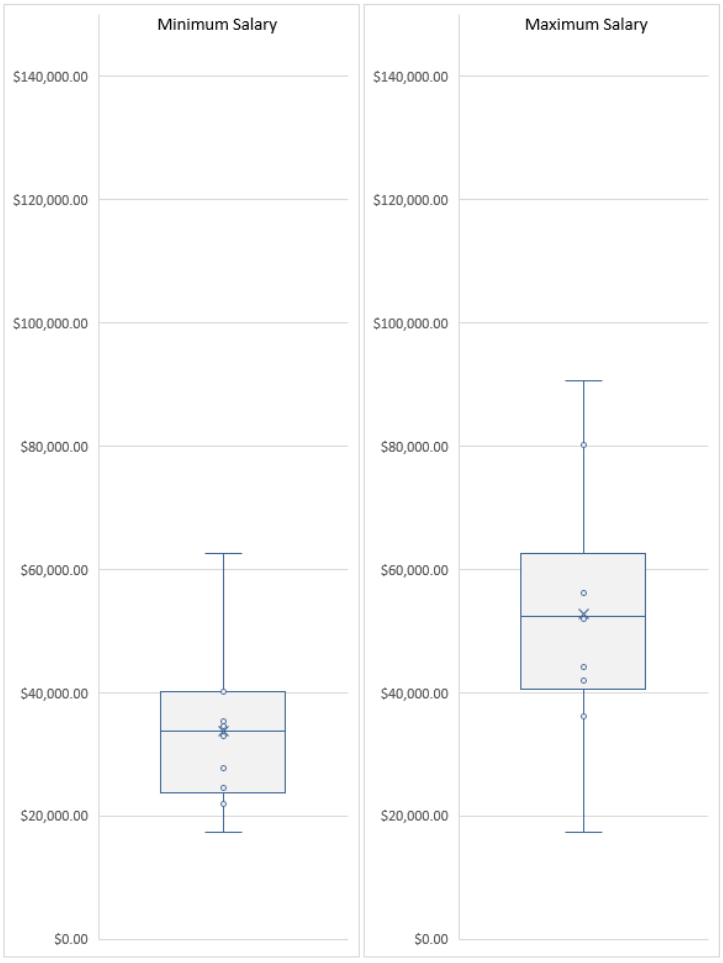


Figure 43: Salary ranges for Support Staff

State Laboratory Program Metrologists

The survey requested specific data on each metrologists on staff in the SLP. These data include details on what measurements the metrologist is authorized to perform, his or her experience (in years) both in the SLP and outside of it, and the calendar year when he or she will be eligible for full retirement.

Lab ID	Name	Email	Mass I	Mass II	Mass III	Vol Trans	Vol Grav	Length	Time/Frequency	Temperature	Grain Moisture	What Year Eligible for Retirement?	State Lab Metrology	Other Metrology	Total Metrology Experience
AK	Garret Brown	garret.brown@alaska.gov	N	Y	Y	Y	Y	N	Y	Y	N	2023	16	8	24
AK	Travis Garding	travis.garding@alaska.gov	N	N	N	N	N	N	N	N	N	2050	1	9	10
AL	Michael Bridges	michael.bridges@agi.alabama.gov			F	F						2027	11	0	11
AL	Anthony Gallagher	anthony.gallagher@agi.alabama.gov			F	F						2041	5	0	5
AR	Eva Ramirez	eva.ramirez@agriculture.arkansas.gov			N	N					Y		2	0	2
AR	John Irvin	john.irvin@agriculture.arkansas.gov			N	N					Y		0	0	0
AR	Matthew Snyder	matthew.snyder@agriculture.arkansas.gov			N	N					Y		0	0	0
AR	Jill Franke	jill.franke@agriculture.arkansas.gov			Y	Y					Y		6	0	6
AR	Nikhil Soman	nikhil.soman@agriculture.arkansas.gov			Y	Y					N		11	0	11
AZ	Brian Sellers	bsellers@azda.gov		Y	Y	Y	Y					2024	16.5	0	16.5
AZ	Mauro Nieves	mnieves@azda.gov										2036	1	0	1
CA	Thomas Benin	Thomas.Benin@cdfa.ca.gov	N	N	N	N	N	N	N	N	N	2054	1.33	0	1.33
CA	Toni Bulai	Toni.Bulai@cdfa.ca.gov	N	Y	Y	Y	Y	Y	Y	Y	N	2040	4.6	9	13.6
CA	Tony Gruneisen	Anthony.Gruneisen@cdfa.ca.gov	N	Y	Y	Y	Y	Y	Y	Y	N	2032	19.5	0	19.5
CO	Kate Smetana	kate.smetana@state.co.us	Y	Y	Y	Y	Y	N	Y	N	Y	2038	8.5	0	8.5
CO	Tiffany Brigner	tiffany.brigner@state.co.us	N	N	N	N	N	N	N	N	N	2029	1	0	1
CO	Andrew Shopes	andrew.shopes@state.co.us	N	N	N	N	N	N	N	N	N	2051	0	0	0
CT	Ana Maria Feliciano	ana.feliciano@ct.gov	N	N	Y	Y	N	N	N	N	N	2040	10	0	10
CT	Ion Daha	ion.daha@ct.gov	N	N	Y	Y	N	N	N	N	N	2033	12	0	12
FL	Amy Smith	Amy.Smith@fdacs.gov	N	Y	Y	Y	N	N	N	N	N	2036	8	0	8
FL	Megan Money	Megan.Money@fdacs.gov	N	Y	Y	Y	N	N	N	N	N	2042	8	0	8
FL	Micheal Kruse	Michael.Kruse@fdacs.gov	N	Y	Y	Y	N	N	N	N	N	2043	6	0	6
FL	Terry Edwards Jr.	Terry.Edwards@fdacs.gov	N	N	N	N	N	N	N	N	N	2050	1	0	1
GA	Kontz Bennett	kontz.bennett@agr.georgia.gov	N	Y	Y	Y	Y	Y	N	N	N	2030	20	0	20
GA	Stan Diffie	stan.diffie@agr.georgia.gov	N	Y	Y	Y	N	N	N	N	N	2027	4	0	4
GA	Justin Odom	justin.odom@agr.georgia.gov	N	N	N	N	N	N	N	N	N	2048	2	0	2
USDA-GIPSA	Marcus Harwitz	marcus.harwitz@usda.gov			Y								9	17	26
HI	Michael Tang	michael.tang@hawaii.gov	Y	Y	Y	Y	Y	N	Y	N	N	2019	20	0	20
IL	Karl Cunningham	karl.cunningham@illinois.gov			Y	Y					Y	2025	16	0	16

Lab ID	Name	Email	Mass I	Mass II	Mass III	Vol Trans	Vol Grav	Length	Time/Frequency	Temperature	Grain Moisture	What Year Eligible for Retirement?	State Lab Metrology	Other Metrology	Total Metrology Experience
IL	John Satterlee	john.satterlee@illinois.gov										2046	3	0	3
IL	Brad Lowery	brad.lowery@illinois.gov										2048	2	0	2
IN	Howard Wickersham	hwickersham@isdh.in.gov		Y	Y	Y	Y					2022	6	4	10
IN	Chris Gast	ggast@isdh.in.gov										2045	1.5	0	1.5
IN	Katelyn Scott	kscott@isdh.in.gov										2050	0.25	0	0.25
KS	Kevin Uphoff	Kevin.Uphoff@ks.gov	Y	Y	Y	Y	Y	N	N	Y	N	2036	9	0	9
KS	Evan Johnson	ClarenceEvan.Johnson@Ks.gov	N	N	Y	Y	N	N	N	N	N	2049	2	0	2
KY	Jason Glass	Jason.glass@ky.gov	N	N	Y	Y	N	N	N	N	N	2027	17	0	17
KY	Chester Watson	chester.watson@ky.gov	N	N	Y	Y	N	N	N	N	N	2034	13	0	13
KY	Bill Baker	bill.baker@ky.gov	N	N	N	N	N	N	N	N	N	2035	13	0	13
LA	Richert W. Williams	richer_w@ldaf.state.la.us			Y	Y						2021	23	0	23
LA	Whitney Corley	wcorley@ldaf.state.la.us			Y	Y						2038	2	0	2
LA	Jennifer Martin	jmartin1@ldaf.state.la.us			N	N						2039	1	0	1
MA	Ray Costa	ray.costa@mass.gov	N	N	Y	Y	N	N	N	N	N	2022	9	36	45
MD	Elizabeth Koncki	elizabeth.koncki@maryland.gov	N	N	N	N	N	N	N	N	Y	2039	7	0	7
MD	Zach Tripoulas	zacharias.tripoulas@maryland.gov	N	N	Y	Y	N	N	N	N	N	2040	6	0	6
MD	Tong Hsu	tong.hsu@maryland.gov	N	N	Y	Y	N	N	N	N	N	2043	5	0	5
ME	Brad Bachelder	bradford.bachelder@maine.gov		Y	Y	Y	Y	Y				2052	8	1	9
MI	Craig VanBuren	vanburenc9@michigan.gov	N	N	N	N	N						21	0	21
MI	Neil Jones	jonesn@michigan.gov	Y	Y	Y	Y	Y						21	0	21
MI	Nick Santini	santinin@michigan.gov	Y	Y	Y	Y	Y						10	0	10
MI	Ryanne Hartman	hartmanr9@michigan.gov	N	Y	Y	Y	Y						10	0	10
MI	Scott Ferguson	fergusons9@michigan.gov	N	Y	Y	Y	Y						10	0	10
MI	Steve Galvan	galvans@michigan.gov	N	N	N	N	N						5	0	5
MI	Nicole Byndas	byndasn@michigan.gov	N	Y	Y	Y	Y						3	5	8
MN	Benj FitzPatrick	Benjamin.FitzPatrick@state.mn.us	Y	Y	Y	Y	Y	N	N	N	N	2047	5.5	0	5.5
MN	Eric Johnson	Eric.E.Johnson@state.mn.us	N	N	N	N	N	N	N	N	N	2047	1.5	4	5.5
MN	Anna Pierce	Anna.Pierce@state.mn.us	N	Y	Y	Y	Y	N	N	N	N	2055	2.5	0	2.5
MN	Heidi Jones	Heidi.Jones@state.mn.us	N	N	N	N	N	N	N	N	N	2025	21	0	21

Lab ID	Name	Email	Mass I	Mass II	Mass III	Vol Trans	Vol Grav	Length	Time/Frequency	Temperature	Grain Moisture	What Year Eligible for Retirement?	State Lab Metrology	Other Metrology	Total Metrology Experience
MN	Valare Falkner	Valare.Falkner@state.mn.us	N	N	N	N	N	N	N	N	N	2055	1.5	0	1.5
MO	John Bell	johnny.bell@mda.mo.gov	N	N	N	N	N	N	N	N	N	2032	0.5	0	0.5
MO	Houston Naugher	houston.naugher@mda.mo.gov	N	y	y	y	y	N	N	N	y	2052	3	0	3
MT	David Fraser	dafraser@mt.gov	N	N	Y	Y	N	N	N	N	N	2030	7	0	7
NC	Sharon Woodard	sharon.woodard@ncagr.gov	Y	Y	Y	Y	Y	Y	N	Y	Y	2022	28.5	0	28.5
NC	Spurgeon Van Hyder	van.hyder@ncagr.gov	Y	Y	Y	Y	Y	Y	N			2024	26.5	0	26.5
NC	Ashley Lessard	ashley.lessard@ncagr.gov	Y	Y	Y	Y	Y	Y	N			2041	9.75	0	9.75
NC	Robert Rogers	robert.rogers@ncagr.gov	Y	Y	Y	Y	Y	Y	N	Y		2041	9.17	8	17.17
NC	April Lee	april.lee@ncagr.gov							N		Y	2042	8.5	0	8.5
NC	Marina Paggen	marina.paggen@ncagr.gov			Y	Y	Y	Y	N			2048	3	0	3
NC	Joshua Hairston	joshua.hairston@ncagr.gov			Y			Y	N			2049	1	0	1
NE	Joel P. Lavicky	joel.lavicky@nebraska.gov			Y	Y						2040	5	0	5
NJ	Michael J. Cecere	CecereM@dca.lps.state.nj.us	N	N	Y	Y	N	Y	Y	N	N	2019	14	0	14
NJ	Kyle C. Pierson	PiersonK@dca.lps.state.nj.us	N	N	Y	Y	N	Y	Y	N	N	2035	5.5	0	5.5
NM	Clay Ivey	civey@nmda.nmsu.edu		Y	Y	Y	Y	N	N	N	N	2030	11	0	11
NM	Ryan Rust	rrust@nmda.nmsu.edu		Y	Y	Y	Y	N	N	N	N	2042	4	0	4
NV	James Kellames	jkellames@agri.nv.gov	N	Y	Y	Y	Y	N	N	N	N	2043	6	0	6
NV	Jerome Plant	jplant@agri.nv.gov	N	Y	Y	Y	Y	N	N	N	N	2027	4	0	4
NV	Kiara Riske	kriske@agri.nv.gov	N	Y	Y	Y	Y	N	N	N	N	2048	3	0	3
NY	Jonathan Fox	jonathan.fox@agriculture.ny.gov		Y	Y	Y	Y	Y	Y			2039	6	0	6
NY	Jeremy Best	jeremy.best@agriculture.ny.gov		N	N	N	N	N	N			2049	2	0	2
NY	Eric Morabito	eric.morabito@agriculture.ny.gov		Y	Y	Y	Y	Y	Y			2021	10	0	10
NY	Michael Lejeune	michael.lejeune@agriculture.ny.gov		Y	Y	Y	Y	Y	Y			2035	6	0	6
NY	Mike Sikula	mike.sikula@agriculture.ny.gov		N	N	N	N	N	N			2021	22	7	29
OH	Tom Buck	tom.buck@agri.ohio.gov	N	Y	Y	Y	Y	Y	Y	N	N	2031	7	0	7
OH	Ken Johnson	ken.johnson@agri.ohio.gov	N	Y	Y	Y	Y	Y	Y	N	N	2020	31	6	37
OH	Daniel Walker	daniel.walker@agri.ohio.gov	N	Y	Y	Y	Y	Y	Y	N	N	2042	9	10	19
OH	Jeff Gibson	jeffrey.gibson@agri.ohio.gov	N	Y	Y	Y	Y	Y	Y	N	N	2030	5	0	5
OK	Jeremy Nading	jeremy.nading@ag.ok.gov	Y	Y	Y	Y	Y	N	N	N	N	2037	15	0	15

Lab ID	Name	Email	Mass I	Mass II	Mass III	Vol Trans	Vol Grav	Length	Time/Frequency	Temperature	Grain Moisture	What Year Eligible for Retirement?	State Lab Metrology	Other Metrology	Total Metrology Experience
OK	Amanda Kramer	amanda.kramer@ag.ok.gov	N	N	Y	Y	N	N	N	N	N	2052	2	0	2
OK	Jacob Whitten	jacob.whitten@ag.ok.gov	N	N	N	N	N	N	N	N	N	2050	1.5	0	1.5
OR	Aaron Aydelotte	aaydelotte@oda.state.or.us	Y	Y	Y	Y	Y	N	N	Y	N	2029	20	0	20
OR	Ray Nekuda	rnekuda@oda.state.or.us	Y	Y	Y	Y	Y	N	N	N	N	2037	13	0	13
PA	James P. Gownley	jgownley@pa.gov	N	Y	Y	Y	Y	Y	Y	N	N	2030	19	0	19
PA	Christopher J. Drupp	cdrupp@pa.gov	N	Y	Y	Y	Y	Y	Y	N	N	2034	13	0	13
PA	Richard M. Radel, Jr.	riradel@pa.gov	N	Y	Y	Y	Y	Y	Y	N	N	2025	12.5	0	12.5
PA	David Welker	dawelker@pa.gov	N	Y	Y	Y	Y	Y	Y	N	N	2022	7.25	0	7.25
PA	Dustin Claycomb	duclaycomb@pa.gov	N	Y	Y	Y	Y	Y	Y	N	N	2031	6.5	5	11.5
SC	Kristin Sherrick	ksherrick@scda.sc.gov		Y	Y	Y	Y	N	N	N	Y	2048	3	0	3
SC	Eric Eliassen	eeliassen@scda.sc.gov		Y	Y	N	N	N	N	N	Y	2027	2	0	2
SC	Lakoia Turner	lturner@scda.sc.gov		N	Y	Y	N	N	N	N	N	2050	1	0	1
SC	Timothy Jones	tjones@scda.sc.gov	N	Y	Y	Y	Y	N	N	N	Y	2044	6	0	6
SD	Ron Peterson	ron.peterson@state.sd.us	N	N	Y	Y	N	N	N	N	Y	2025	9	0	9
TN	Nicholas Andersen	Nicholas.Andersen@TN.gov			Y	Y							4	0	4
TN	Rong Zhang	Rhong.Zhang@TN.gov			Y								2	0	2
TN	Sara Perdue	Sara.Perdue@TN.gov											1	0	1
TX	Preston Adachi	preston.adachi@texasagriculture.gov	N	Y	Y	Y	Y	N	N	N	N	2015	15	30	45
TX	Daniel Gibbons	daniel.gibbons@texasagriculture.gov	N	Y	Y	Y	Y	N	N	N	N	2024	17	0	17
TX	Lisa Corn	lisa.corn@texasagriculture.gov	Y	Y	Y	Y	Y	N	N	N	N	2035	13	0	13
TX	Keri Schatte	keri.schatte@texasagriculture.gov	N	N	Y	N	N	N	N	N	N	2038	4	0	4
UT	Bill Rigby	brigby@utah.gov			Y	Y						2030	16	0	16
VA	William Scott	william.scott@vdacs.virginia.gov	Y	Y	Y	Y			Y			2045	6	5	11
VA	William Loving	william.loving@vdacs.virginia.gov	Y	Y	Y	Y			Y			2020	31	0	31
VT	Marc Paquette	marc.paquette@vermont.gov	N	N	Y	Y	N	N	N	N	N	2021	15	0	15
VT	Scott Dolan	scott.dolan@vermont.gov	N	N	Y	Y	N	N	N	N	N	2041	9	0	9
WA	Leslie German	lgerman@agr.wa.gov	Y	Y	Y	Y	Y	N	Y	N	N	2029	4	0	4
WI	Justin Lien	justin.lien@wisconsin.gov	N	N	Y	Y	N	N	Y	N	N	2044	7	0	7
WI	Paul Masterson	paul.masterson@wisconsin.gov	N	N	Y	Y	N	N	Y	N	N	2045	6	0	6

Lab ID	Name	Email	Mass I	Mass II	Mass III	Vol Trans	Vol Grav	Length	Time/Frequency	Temperature	Grain Moisture	What Year Eligible for Retirement?	State Lab Metrology	Other Metrology	Total Metrology Experience
WI	Ronald DePouw	ronald.depouw@wisconsin.gov	N	N	Y	Y	N	N	Y	N	N	2047	4	0	4
WI	Bradley Wing	bradleya.wing@wisconsin.gov	N	N	Y	N	N	N	N	N	N	2047	4	0	4
WV	Anthony O'Brien	anthony.p.obrien@wv.gov	N	N	Y	Y	N	N	N	N	N	2026	23	0	23
WV	Steven Nehls	steven.b.nehls@wv.gov	N	N	Y	Y	N	N	N	N	N	2045	2	0	2
WY	Robert Weidler	robert.weidler@wyo.gov			Y	Y						2029	12	0	12
WY	Todd Stiles	todd.stiles@wyo.gov			Y	Y						2032	5	0	5

Table 45: Listing of SLP metrologists as of 2020. Each metrologist was asked to indicate which of the listed calibrations they are authorized to perform ("F" = Full authority, "N" = Not authorized, "P" = partial or limited authority), provide what year they are eligible for retirement, and to provide a measure of their metrology experience.

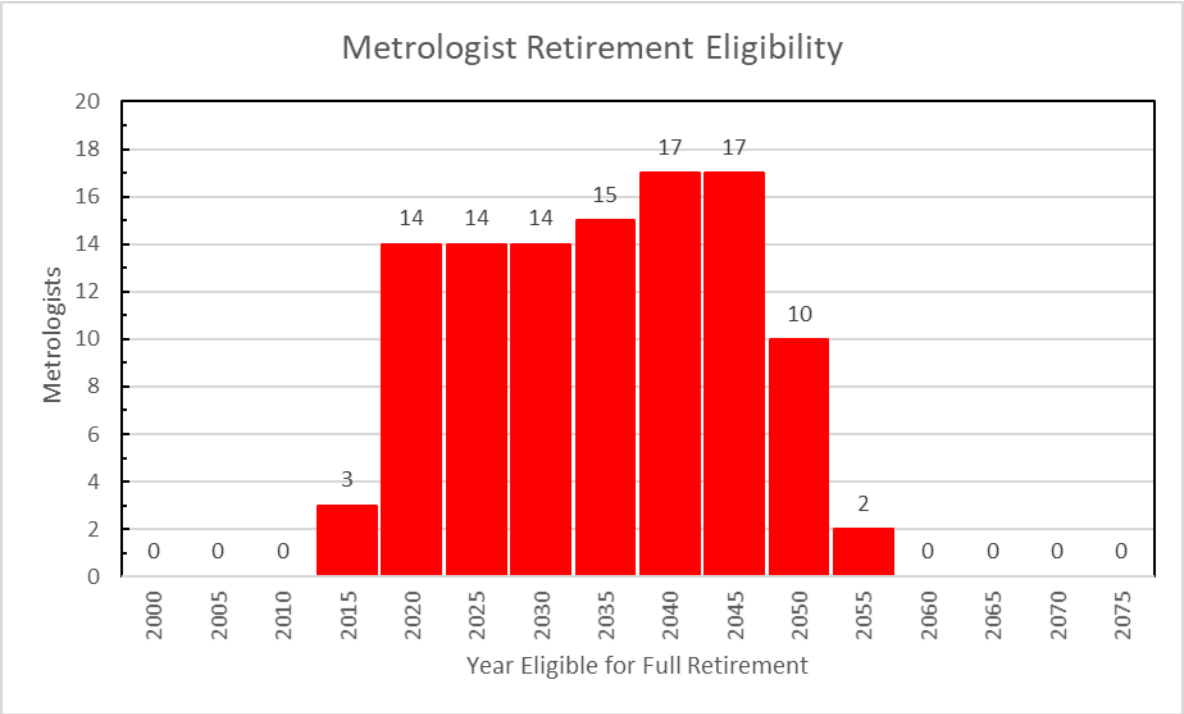


Figure 44: Retirement Eligibility Histogram. Of the 122 metrologists, 106 reported the year they would be eligible for full retirement. This may not reflect when any one person actually plans to leave the SLP.

Measurement Category	
Mass I	17
Mass II	55
Mass III	92
Vol Trans	86
Vol Grav	49
Length	24
Time/Frequency	25
Temperature	7
Grain Moisture	14

Table 46: 122 Metrologists reporting. Metrologists were asked to indicate which type of calibrations they are authorized to perform on behalf of their respective laboratories.

State Laboratory Program/Metrology Experience

Description

Total Metrology Experience:

Each metrologist was asked to report their metrology experience in years. The data was broken down into two categories, years of experience in the SLP, and years metrology experience outside the SLP.

Comparison of previous surveys

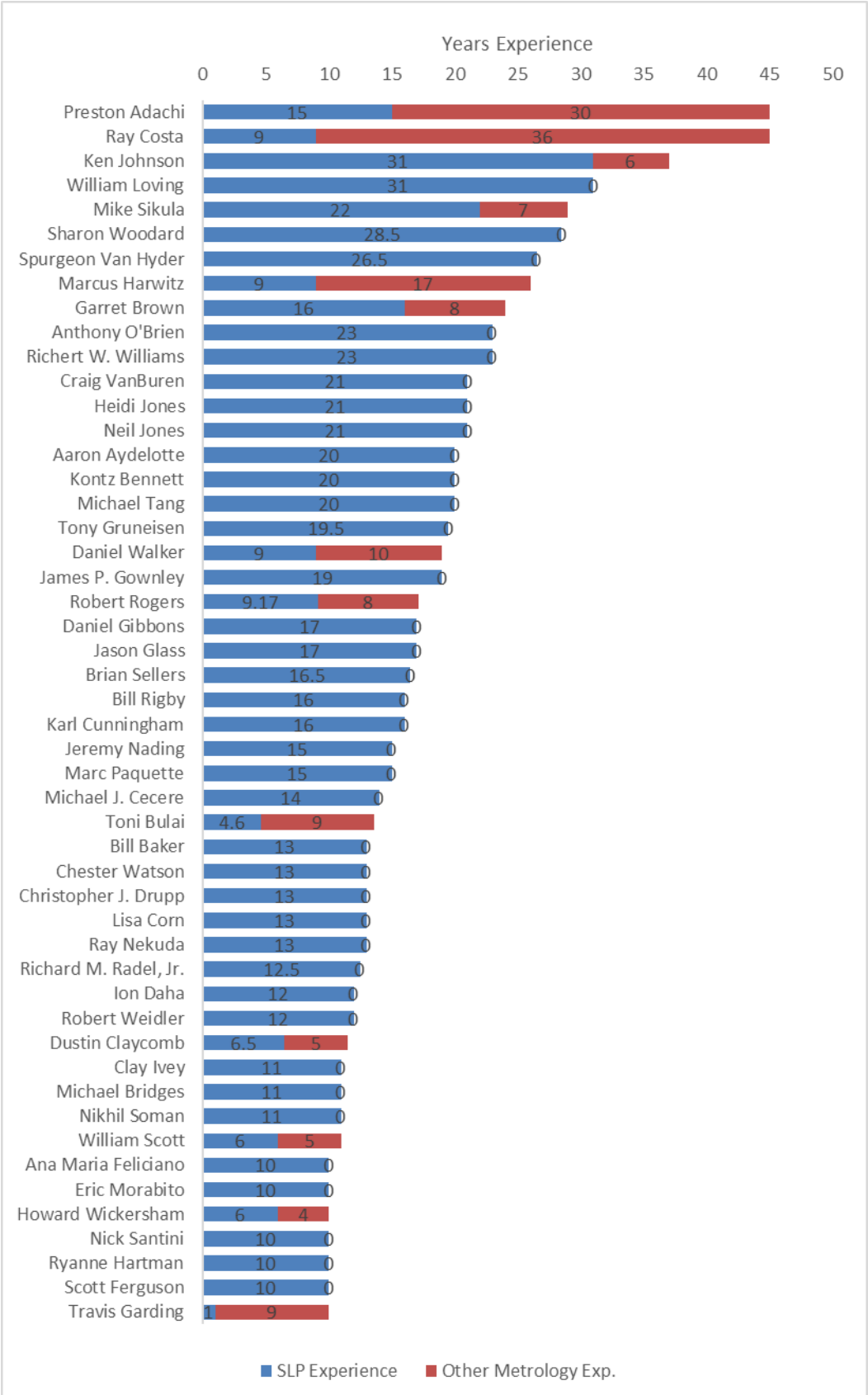
	Number of Metrologists	Average SLP Experience	Average Other Experience	Average Total Experience
2000	111	8.7	2.4	11.0
2002	113	9.1	2.1	11.2
2004	111	8.1	2.6	10.8
2006	112	8.3	3.1	11.4
2008	125	9.2	2.4	11.6
2010	121	9.5	1.9	11.4
2012	110	8.7	2.1	10.8
2014	118	9.2	1.7	10.9
2016	116	8.8	2.8	10.3
2018	119	9.3	1.4	10.7
2020	122	8.5	1.3	9.8

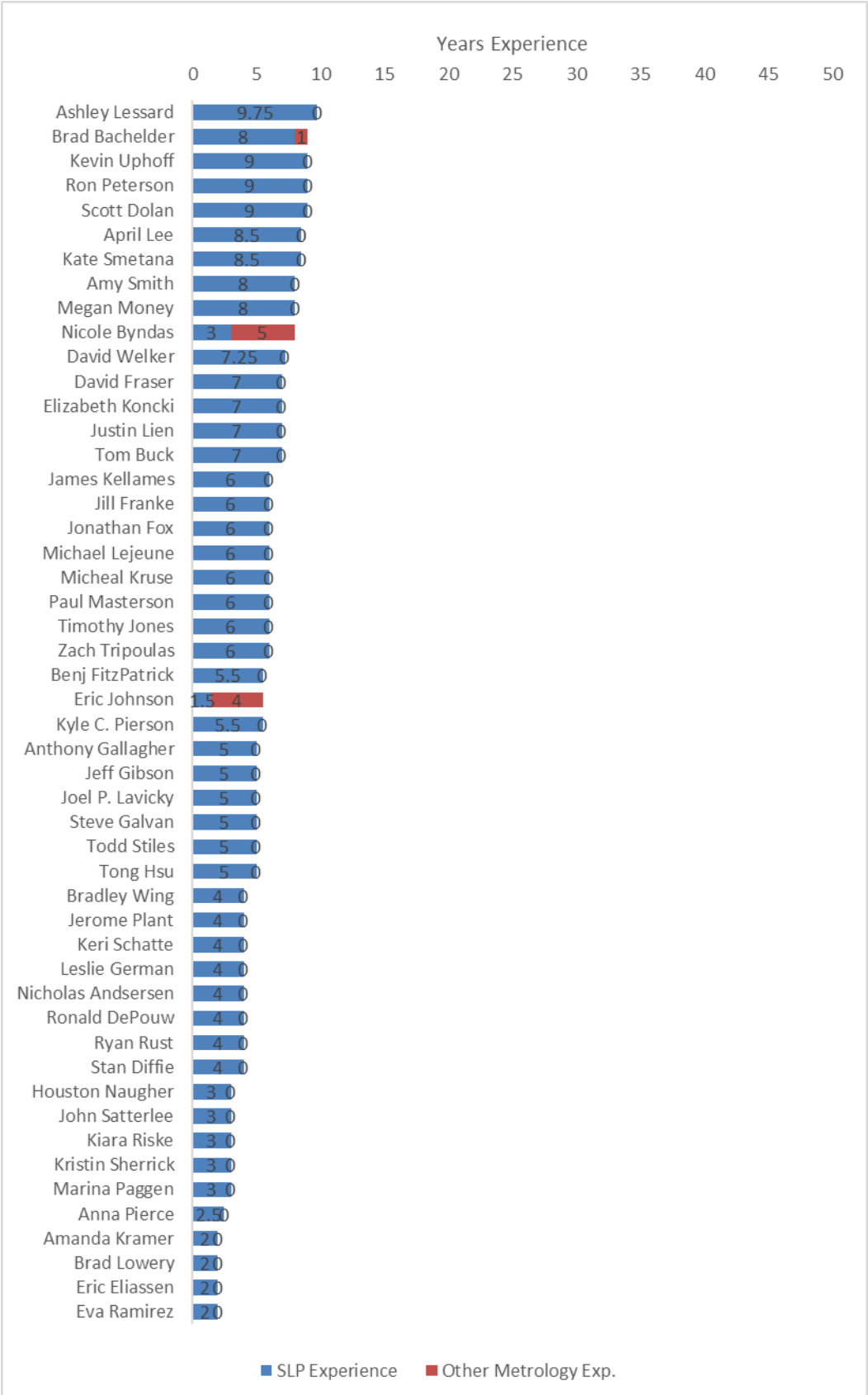
Table 47: Comparison matrix summarizing metrology experience reported by metrologists.

Comments:

- Data was collected for 122 metrologist in the SLP from 44 laboratories.
- Each metrologist reports an average of 8.5 years the SLP experience each.
- Each metrologist reports an average of 1.3 years “other” experience each.
- Each of the 16 metrologist reporting “other” experience reports an average of 10.3 years of relevant experience.
- Each metrologists report an average of 9.8 years total experience each.

NOTE: The survey team is aware some of the metrologists identified in this list are either full time weights and measures employees working part time in the laboratory due to promotions or transfers or are working as post retirement contractors to help maintain laboratory recognition or accreditation. These individuals tend to be more senior and thus skew the overall measures of experience and retirement risk high.


Years Experience
0 5 10 15 20 25 30 35 40 45 50
Preston Adachi 15 30
Ray Costa 9 36
Ken Johnson 31 6
William Loving 31 0
Mike Sikula 22 7
Sharon Woodard 28.5 0
Spurgeon Van Hyder 26.5 0
Marcus Harwitz 9 17
Garret Brown 16 8
Anthony O'Brien 23 0
Richert W. Williams 23 0
Craig VanBuren 21 0
Heidi Jones 21 0
Neil Jones 21 0
Aaron Aydelotte 20 0
Kontz Bennett 20 0
Michael Tang 20 0
Tony Gruneisen 19.5 0
Daniel Walker 9 10
James P. Gownley 19 0
Robert Rogers 9.17 8
Daniel Gibbons 17 0
Jason Glass 17 0
Brian Sellers 16.5 0
Bill Rigby 16 0
Karl Cunningham 16 0
Jeremy Nading 15 0
Marc Paquette 15 0
Michael J. Cecere 14 0
Toni Bulai 4.6 9
Bill Baker 13 0
Chester Watson 13 0
Christopher J. Drupp 13 0
Lisa Corn 13 0
Ray Nekuda 13 0
Richard M. Radel, Jr. 12.5 0
Ion Daha 12 0
Robert Weidler 12 0
Dustin Claycomb 6.5 5
Clay Ivey 11 0
Michael Bridges 11 0
Nikhil Soman 11 0
William Scott 6 5
Ana Maria Feliciano 10 0
Eric Morabito 10 0
Howard Wickersham 6 4
Nick Santini 10 0
Ryanne Hartman 10 0
Scott Ferguson 10 0
Travis Garding 1 9
SLP Experience
Other Metrology Exp.


Years Experience
0 5 10 15 20 25 30 35 40 45 50
Ashley Lessard 9.75 0
Brad Bachelder 8 1
Kevin Uphoff 9 0
Ron Peterson 9 0
Scott Dolan 9 0
April Lee 8.5 0
Kate Smetana 8.5 0
Amy Smith 8 0
Megan Money 8 0
Nicole Byndas 3 5
David Welker 7.25 0
David Fraser 7 0
Elizabeth Koncki 7 0
Justin Lien 7 0
Tom Buck 7 0
James Kellames 6 0
Jill Franke 6 0
Jonathan Fox 6 0
Michael Lejeune 6 0
Micheal Kruse 6 0
Paul Masterson 6 0
Timothy Jones 6 0
Zach Tripoulas 6 0
Benj FitzPatrick 5.5 0
Eric Johnson 1.5 4
Kyle C. Pierson 5.5 0
Anthony Gallagher 5 0
Jeff Gibson 5 0
Joel P. Lavicky 5 0
Steve Galvan 5 0
Todd Stiles 5 0
Tong Hsu 5 0
Bradley Wing 4 0
Jerome Plant 4 0
Keri Schatte 4 0
Leslie German 4 0
Nicholas Andsersen 4 0
Ronald DePouw 4 0
Ryan Rust 4 0
Stan Diffie 4 0
Houston Naugher 3 0
John Satterlee 3 0
Kiara Riske 3 0
Kristin Sherrick 3 0
Marina Paggen 3 0
Anna Pierce 2.5 0
Amanda Kramer 2 0
Brad Lowery 2 0
Eric Eliassen 2 0
Eva Ramirez 2 0
SLP Experience
Other Metrology Exp.

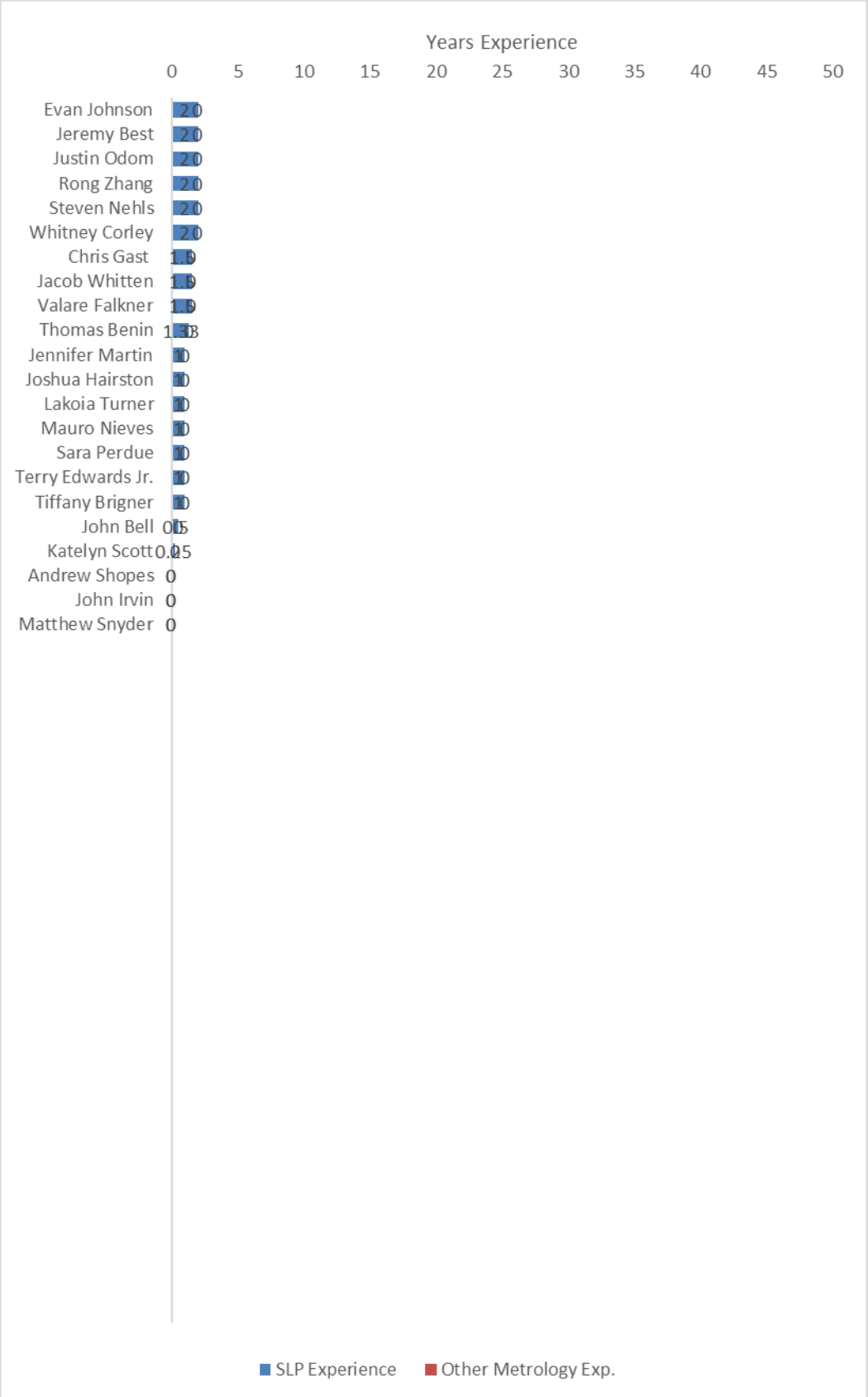


Figure 45: SLP metrologists ranked by years of experience (cont). Blue indicates experience in the SLP, Red indicates other metrology experience.

Acknowledgment of Calibration Certificates Matrix

Each member laboratory was asked to identify what laboratories it will accept calibration certificates from. The choices were:

- From your laboratory ONLY[12].
- Any of the SLP member labs.
- Any SLP member lab having NIST/OWM Recognition.
- Any NVLAP Accredited Lab.
- Any Weight Manufacturer regardless of accreditation status.
- Any laboratory accredited by an accreditation body that is an ILAC signatory.

Lab ID	Your State Lab Only	Any State Lab Regardless of Status	Any NIST/OWM Recognized Lab	Any NVLAP Accredited Lab	Any Weight Manufacturer Regardless of Accreditation Status	Any Company or Lab that is Accredited by an Accreditation Body that is an ILAC Signatory
AK	No	No	Yes	Yes	No	Yes
AL	No	No	Yes	No	No	No
AR	No	No	Yes	Yes	No	Yes
AZ	No	No	Yes	Yes	No	Yes
CA	No	No	Yes	Yes	No	Yes
CO	Yes	No	Yes	Yes	No	Yes
CT	No	No	Yes	Yes	No	Yes
FL	Yes	No	Yes	Yes	No	Yes
GA	No	No	Yes	Yes	No	No
USDA-GIPSA	No	No	No	Yes	No	No
HI	No	No	Yes	Yes	No	No
IL	No	No	Yes	Yes	No	No
IN	Yes	No	No	Yes	No	Yes
KS	No	No	Yes	No	No	Yes
KY	No	No	Yes	Yes	No	Yes
LA	No	No	Yes	Yes	No	No
MA	No	No	Yes	Yes	No	Yes
MD	No	No	Yes	Yes	No	No
ME	No	No	Yes	Yes	No	No
MI	No	No	Yes	Yes	No	Yes
MN	No	No	Yes	Yes	No	No

[12] This choice should have been exclusive of the other options. Some respondents may have answered this question assuming that this meant they would accept their own certificates in addition to others as identified.

Lab ID	Your State Lab Only	Any State Lab Regardless of Status	Any NIST/OWM Recognized Lab	Any NVLAP Accredited Lab	Any Weight Manufacturer Regardless of Accreditation Status	Any Company or Lab that is Accredited by an Accreditation Body that is an ILAC Signatory
MO	No	No	Yes	Yes	No	Yes
MT	No	Yes	Yes	Yes	No	Yes
NC	No	No	Yes	Yes	No	Yes
NE	No	No	Yes	Yes	No	No
NJ	Yes	No	Yes	No	No	No
NM	No	No	No	No	No	No
NV	No	No	Yes	Yes	No	Yes
NY	No	No	Yes	Yes	No	Yes
OH	No	No	Yes	No	No	No
OK	Yes	No	Yes	Yes	No	Yes
OR	No	No	Yes	Yes	No	Yes
PA	No	No	Yes	No	No	No
SC	No	No	Yes	Yes	No	Yes
SD	Yes	No	Yes	Yes	No	No
TN	No	No	Yes	No	No	No
TX	No	No	Yes	Yes	No	Yes
UT	No	No	Yes	Yes	No	Yes
VA	No	No	Yes	Yes	No	Yes
VT	No	No	Yes	Yes	No	Yes
WA	No	No	Yes	Yes	No	Yes
WI	No	No	Yes	Yes	No	Yes
WV	No	No	Yes	Yes	No	Yes
WY	No	No	Yes	Yes	No	Yes

Table 48: Calibration Certificate acceptance matrix.

NOTE: The question of calibration acceptance seems to be a bit vague. One could take it to mean acceptance of a calibration certificate from a service provider for the calibration of measure and testing equipment used by the laboratory to carry out its work. Another interpretation involves the acceptance of those calibration certificates submitted by service agents registered or licensed by the state or county weights and measures program. A third interpretation would look at any calibration certificate submitted to the laboratory regardless of reason. The survey team cannot infer how each respondent interpreted the question.

Supplementary Questions

Some biannual surveys include a section covering subjects of potential interest by NIST OWM and the SLP member laboratories. These supplementary questions are designed to require only a minimum of research time in order to answer and the answers themselves are generally limited to one word, multiple choice responses.

Historical Supplementary Questions

- 2003 – Miscellaneous questions
- 2010 – Use of national and international standards (HB 105 series, OIML, ASTM)
- 2014 – Who do you use for calibration services; Time to calibrate measure and test equipment.
- 2016 – Weight cleaning policy, Masscode revision in service, largest weight cart, relative metric workload, and service request tracking.
- 2018 – Acceptance criteria for MTE coming into the lab for calibration (cast iron and test measures). Calibration services requested by customers but not offered by the lab. What version of Excel are you using?
- 2020 – Questions related to COVID-19 impact on lab operations.

In 2018 a standardized format for including supplemental questions was introduced into the survey. Section 1 includes a bank of up to 10 yes or no questions. Section 2 includes a bank of up to 10 short answer questions.

Supplementary Questions Section 1

Question	Yes	No
Did COVID delay having your lab standards calibrated or accredited?	15	29
Did COVID delay staff training (NIST provided or internal)?	27	16
Did you defer the purchase of new lab equipment in 2020 because of COVID?	12	31
Did you experience other budget cuts?	16	24
Did you have mandatory furlough time in 2020 because of COVID?	13	30
Did your workload decrease in 2020 because of COVID?	20	21
Did your workload increase in 2020 because of COVID?	9	32
If your lab is relocating, will the move delay having your lab standards calibrated and recertified?	1	0
Were you required to hold a vacant metrology position open because of budget cuts due to COVID?	1	36

Table 49: Summary of responses to supplementary questions in section 1.

1) Did your workload increase in 2020 because of COVID?

Yes: AK,AR,AZ,FL,IN,MO,NE,OK,VA
No:AL,CA,CO,CT,GA,HI,IL,KY,LA,MA,MD,ME,MI,MN,MT,NC,NJ,NM,NV,NY,OH,OR,PA,SC,SD,TN,TX,USDA-GIPSA,UT,WA,WI,WV

2) Did your workload decrease in 2020 because of COVID?

Yes: AK,CA,CO,CT,FL,GA,HI,LA,MD,ME,MN,NC,NJ,NM,NY,PA,SC,WA,WI,WV
No: AL,AR,AZ,IL,IN,KY,MI,MO,MT,NE,NV,OH,OK,OR,SD,TN,TX,USDA-GIPSA,UT,VA,VT

3) Did you have mandatory furlough time in 2020 because of COVID?

Yes: AL,CA,CO,IN,LA,MD,MI,NV,NY,PA,SC,SD,WA
No: AK,AR,AZ,CT,FL,GA,HI,IL,KS,KY,MA,ME,MN,MO,MT,NC,NE,NJ,NM,OH,OK,OR,TN,TX,USDA-GIPSA,UT,VA,WI,WV,WY

4) Did you experience other budget cuts?

Yes: AK,CA,CO,GA,HI,IN,MD,ME,MI,MN,MO,NJ,NV,OH,USDA-GIPSA,WY
No: AL,CT,FL,IL,KS,KY,LA,MA,MT,NC,NE,NM,NY,OK,OR,PA,SD,TN,TX,UT,VA,VT,WA,WV

5) Did you defer the purchase of new lab equipment in 2020 because of COVID?

Yes: CA,HI,IN,MI,MN,MO,NJ,NV,SC,TN,WI,WV
No: AK,AL,AR,AZ,CO,CT,GA,IL,KS,KY,LA,MA,MD,ME,MT,NC,NE,NM,NY,OH,OK,OR,PA,SD,TX,USDA-GIPSA,UT,VA,VT,WA,WY

6) Were you required to hold a vacant metrology position open because of budget cuts due to COVID?

Yes:MO
No:AK,AL,AR,AZ,CA,CO,CT,FL,GA,HI,IL,IN,KY,LA,MA,ME,MN,MT,NC,NE,NJ,NM,NV,NY,OK,OR,SC,SD,TN,TX,USDA-GIPSA,UT,VA,WI,WV,WY

7) Did COVID delay having your lab standards calibrated or accredited?

Yes: AK,AR,CO,CT,HI,IN,KS,KY,MD,NE,NJ,OK,SC,WA,WV
No: AL,AZ,CA,FL,GA,IL,LA,MA,ME,MI,MN,MO,MT,NC,NM,NV,NY,OH,OR,PA,SD,TN,TX,USDA-GIPSA,UT,VA,VT,WI,WY

8) Did COVID delay staff training (NIST provided or internal)?

Yes: AK,AR,AZ,CA,CO,GA,IL,IN,KS,KY,LA,MA,MD,MI,MN,MO,MT,NC,NM,NY,OK,SC,TN,USDA-GIPSA,WI,WV,WY
No: AL,CT,HI,ME,NE,NJ,NV,OH,OR,PA,SD,TX,UT,VA,VT,WA

Table 50: Summary of responses to supplementary questions in section 1.

Supplementary Questions Section 2

Laboratories were asked to list up to 10 requests for calibration services that they are currently unable to provide. Responses are listed here alphabetically.

AK - Echelon I Mass
AK - Thermometry out of scope range
AK - Gauge blocks
AK - Dead weight piston surface area
AL - Customers wanting a higher class than we can calibrate
AL - customers wanting to get weight carts calibrated
AR - Customer asked for ASTM 5 calibration; referral to a different state lab.
AR - Customer requested calibration for test measures greater than 5 gallon standard. Referral to Missouri or Texas.
AR - Customer asked for calibration for 3-1250 lb weights. It is out of our scope.
CA - Field calibrations of 25 lb and 50 lb weights
CA - Field calibrations of 5 gal and greater volume transfer
CA - Field calibrations of LPG provers
CT - Mass Echelon II - Some customers have asked for calibration of Mass Echelon II weights but the lab is not recognized for that so service was not provided.
FL - Thermometry
FL - Echelon I calibrations
FL - Rail carts
GA - Calibration services to non-licensed customers
GA - Calibration services to other state metrology labs
GA - Calibration services to customers of other states
USDA-GIPSA - 1000 lb weights
USDA-GIPSA - 50 lb weights
USDA-GIPSA - 25 lb weights
HI - thermometers
HI - pressure measurement devices
IN - Class 2 calibrations
IN - Class I calibration of Pharmacy Kits
IN - Time Clock calibrations
IN - Non Mototrized Rail Weight cart calibration.
IN - Length Calibrations
IN - Preasure Guages
KS - Mass Echelon I
KS - Gauge Blocks
KY - Tolerance Test 5 kg weights
LA - Echelon II precision testing
MA - Class 1 weight kits (two or three per year at most)
MD - Request 1000 lb cast iron calibration, outside of lab scope
MD - Request large volume prover (>50 gallon) volume transfer method, outside of lab scope
MD - Request LPG, outside of lab scope
ME - temperature
ME - ASTM class 1
MN - Several request for Masterscale calibrations during winter months. (our master scale is closed Nov - April).
MO - Mass II - Restoring recognition status
MO - Volume I Gravimetric - Restoring recognition status
NC - Gauge Blocks
NC - Pressure Gauges
NE - kg mass > 30 kg
NE - Echelon II mass calibrations
NJ - Non Covid Related - Gravimetric Calibrations of 1 and 2 gallon test measures used by the NJ Weights and Measures program. NJ has participated in 2 proficiency tests and has developed control charts with the intention of requesting NIST laboratory recognition for these test measures.
NV - Pippettes
NV - Thermometers
NV - Length
NY - Tape measures made of fiberglass
NY - Gage blocks
NY - Stopwatches that don't meet NIST SOP 24 precision
NY - Masses larger than 500 lbs (until we obtained equip)
PA - Mass Echelon I

PA - Thermometers
PA - LP Prover Calibrations
SC - Calibrations of Echelon II above 100 g (SOP 4,5)
SD - 25 gal, 50 gal and 100 gal LPG provers
TN - Weight Carts
TN - Echelon II Mass
TN - LPG Provers
UT - Unable to perform Echelon 1 requests, facility and training requirements not met.
VT - ASTM 4 Stainless Steel 10 kg and 20 kg
VT - Steel Tapes 25 feet to 102 feet
VT - Class 2 Weights 1 mg to 500 mg, 1 kg to 5 kg
VT - Glassware 1 gil to 0.5 gallons, 50 mL to 2000 mL
WA - gravimetric-glassware. On scope for internal use only.
WI - Class I and/or Class II Weight Kit Calibrations
WV - volume less than 5 gallon

Table 51: Responses to supplementary questions #1-#10 in section 2

Laboratories were asked to identify which version of Excel they are currently using. Responses are listed here alphabetically.

AK - 2016
AL - 2016
AR - 365
CA - "Version 2008 (Build 13127.21216 click to run)"
CO - 2016
CT - 10
FL - 2016
GA - Microsoft 365 for Enterprise Version 2102 (Build 13801.20294); 1997 to 2003 compatability mode is still utilized for some excel documents.
USDA-GIPSA - Excel for Microsoft Office 365
HI - 97-2003,2007, for Microsoft 365
IL - 2016
IN - Excel 365, Operating system is Windows 10
KS - Microsoft Excel for Office 365, Version 2101 (Build 13628.20380 Click-to-Run)
KY - Excel 2016
LA - 2010
MA - Microsoft Office Professional Plus 2013
MD - 2016
ME - 2016
MI - Office 365 ProPlus
MN - 2008
MO - Excel 2016
MT - 2019. Excel Version 1902.
NC - Microsoft Excel for Office 365 MSO (16.0.11901.20070) 32-bit
NE - Office 365
NJ - Excel 2016
NM - 2016
NV - 2008 version of Excel for Microsoft 365
NY - 2016
OH - Excel for MS Office 365 (2008)
OK - Excel 2016
OR - Mac Version 16
PA - Microsoft Excel for Microsoft 365 MSO (16.0.13628.20128)
SC - Version 2008
SD - 2008/ Excel for Microsoft 365
TN - Excel 365
TX - 2000
UT - 2010
VA - 2016
VT - the current one
WA - 2016
WI - Microsoft Office 365
WV – 2016
WY – 2019

Table 52: Excel versions used by laboratories.

Laboratories were asked to briefly describe any safety protocols implemented by their laboratory to cope with COVID-19 (i.e. mandatory masks, limited face to face interactions, sanitation requirements). Responses are listed here alphabetically.

AK - Hand washing, masks, social distancing. Incoming artifacts were "quarantined" for 3 days early on. The building was closed to the public.
AR - Mandatory masks when social distancing isn't possible.
CA - Masks when away from desks, Nobody except staff unless necessary, document who comes and goes from lab, receive and return equipment outside of lab.
CO - mandatory masks, limited room/building capacities, voluntary division wide weekly COVID testing, daily temperature and symptom recording sheets.
CT - Use of mask all the time inside the building. Frequent washing of hands or use of hand sanitizer when washing is not possible. Use of gloves whenever possible. Customers are not allowed to enter the lab. Customers call and schedule the drop off/pick up of equipment and equipment is left outside the building so there is no direct interaction with customers. Metrologist works alone in the lab.
FL - Mandatory masks, customers not allowed in the building, sanitation requirements including but not limited to hand washing, wearing gloves when in contact with customer equipment. The lab uses of MS Teams, email, and phone calls for communication to limit face to face interactions.
GA - Self-temperature screening before reporting to the lab is required. Masks are required to be worn. Customers are restricted to only the metrology lab section. When possible, we are asked to telework. We are also asked to consult with others by phone instead of in-person when possible, and the usual stand 6 feet apart.
USDA-GIPSA - Mandatory face coverings, hand sanitizing and social distancing.
HI - mandatory face masks (except by yourself in your office), hand sanitizer use, social distancing (6 ft between people), no lunch room use, no gatherings or parties, wipe down and sanitize weight containers, weights and small provers
IL - The laboratory followed the guidelines of the Illinois Department of Public Health and the CDC.
IN - 1st Mask to be worn when away from desk. 2nd Maintain 6 ft distance when speaking with customers. 3rd Sterilization of all equipment when they arrive at the labs. Small kits go to the sanitation room for UL light exposure for a least 5 - 10 minutes. the large mass weights are treated with a hand held UV light for 5 minutes.
KS - Mandatory face coverings for staff and visitors, hand sanitizer and wipes at all entry points, visitor log for contact tracing, sanitation of common surfaces and door knobs, and limited face to face meetings and customer interactions.
KY - mask were required in the building at all times, social distancing of six feet or greater was to be observed if possible. Extra hand sanitizer was provided.
LA - mandatory mask when personnel are occupying the same room, visitors have limited access and must wear mask at all times. 14 day home isolation and negative covid test when there has been exposure to positive covid person or contact with someone who has come in contact with a positive tested person.
MA - Outside entry doors always locked, masks required at all times for entry, specific area outside roped off for delivery and pickup of equipment, hand sanitizers at many locations throughout the lab, limited number of occupancy at any one time, exterior of submitted equipment (weight cases, ss test measures) swabbed with antibacterial wipes, etc..
MD - Masks required within building, limited one person per room and hallway at the same time, sanitation as often as possible (hand sanitizer and surface sanitization wipes provided), no customer allow into building unless requested ahead, only one entrance for the building and all office employees screen for temperature and covid related question every time entering the building. Lab limited contact with customer by handling all drop off artifacts and paper work outside of the loading dock with mask on.
ME - Masks, 6 ft distance where possible, work from home when possible
MI - Masks are required except when working at your own desk, customers are not allowed in the lab except when necessary to operate equipment (weight carts, SVPs), door handles and frequently touched surfaces are sanitized twice a day, health screening questionnaire has to be filled out daily by staff, health screening questionnaire and temperature checks required for customers when they are needed to be in the building, only essential staff are allowed in the building, new intercom installed at back door to limit customer contact at the main entrance.
MN - We have locked all of our entrances and require health screening/temperature checks for anyone that will be in the building longer than 10 minutes. We require masks in all spaces, expect personal offices, cubical or laboratory space and only when you are working independently. We have enhanced daily cleaning procedures for the office and lab spaces. We disinfect artifact if able (kit handles, measure handles).
MO - Masks required for employees and customers and restriction of customers entering lab facility
MT - Masks to be worn when customers or non-laboratory personnel present. No mask required when only office personnel present.
NC - Face Mask within 6 ft or 15 min face to face interactions. Hand washing; Hand Sanitizer
NE - Masks are required and all customers have limited access to the building. Lab staff does try to sanitize when needed, Shipments are disinfected when received.
NJ - The Inspectors of the NJ OWM have been deemed "Essential Workers" by the Governor's Office and were required to resume their duties. To address the risks of exposure, the Superintendent of NJ OWM had created a Personal Protection Equipment (PPE) Committee. Each section of the NJ OWM has an employee that participates, and Mr. Kyle Pierson is both the Chairperson and the representative for Metrology. The committee developed safety protocols, which includes the necessary equipment, to ensure that the OWM staff can perform their functions and avoid risk of exposure to Covid-19. In addition to that committee, the Metrology Laboratory created Covid-19 protocols to supplement NJ SAP:

Handling and Storage of Calibration and Test Items. These additional protocols, drafted and approved in June 2020, were put into place to address the risks of exposure as a result of contact with both laboratory customers and their equipment. These protocols have been modified over time as more information becomes available regarding the spread of Covid-19. The most current protocols in place for the entire NJ OWM facility include locked doors throughout the complex, mandatory face coverings/masks and social distance protocols. Submission of items for calibrations are made by appointment only, and the receipt of items submitted is given to customers by email.
NM - We wear mask in the lab and around customers, we wipe down as much as we can (kits, test measures,door handles, etc.) with sanitizing wipes
NV - Mandatory face masks 6 ft social distancing Surfaces are wiped down with disinfectant after use Limited face to face interactions by working both at home and in the office All tested items must sit for 2-3 days for decontamination before being calibrated Customer standards are not handled with bare hands
NY - Mandatory masks, limited visitation to lab by non-lab personnel, no lab tours. The lab's high-touch surfaces are sanitized daily but not by lab personnel.
OH - Mandatory masks Distanced personnel Alternating telework schedules
OK - Face Masks
OR - Masks, hand sanitizer, cleaning of shared areas, 6 ft distancing
PA - Mandatory mask wearing was implemented with eased restriction in defined circumstances. Direct access to the lab by the general public is currently prohibited.
SC - All staff worked from home for a period of time. Masks at all times. No customers in the facility. Limited staff at the lab for a period of time. Wearing gloves when calibrating test weights. 6 feet apart at all times if not able, mask at all times.
SD - Use of sanitizers and avoiding close contact.
TN - We all wear masks outside of our respective offices and we using disposable gloves when interacting with artifacts. Communal areas are also regularly disinfected by cleaning staff.
TX - Skeleton Crew Lab staff to reduce exposure; masks required; no public restrooms; no external visitors aside from customer drop offs;
UT - Mandatory masks. Isolation, only one individual in lab. Cleaning equipment when it arrives at lab.
VA - Mandatory mask, no clients in lab and questionnaire for anyone entering the building
VT - We have mandatory mask requirements for all staff and people delivering artifacts. Those dropping off equipment don't enter the building. We don't have more than 3 people working in the lab at any one time.
WA - State mandated face masks and social distancing on all state property. Those that can are working from home, but the metrology lab is a one person lab so it did not affect me. Early on, all deliveries were put into 'quarantine' for three days per CDC guidelines. More recently, deliveries are processed as they are received. CDC research has shown that Covid transmission from packages is highly unlikely. Visitor log for anyone actually coming into the offices for tracking. Those dropping off in the bay don't have to sign in. There are 'clean' stations at both exits with disposable masks, hand wipes, sanitizing spray, and sanitizing wipes.
WI - mandatory masks - at all times, from start/end of shift. Social distance as much as reasonably possible - staff relocated workstations throughout the laboratory. Additionally, lab staff maintain a large supply of wipes and hand sanitizer that can be found throughout the lab. Routine cleaning/sanitizing of work stations upon completion of a project or calibration.
WV - mandatory masks, social distancing, temperature each day and recorded, sanitation of building, no congregating, clean desk and other working areas frequently
WY - State implemented mask mandate and telework (for those that could). Laboratory did not implement any additional protocols and assigned staff have worked in the lab per normal operating procedures.

Table 53: COVID-19 protocols implemented by laboratories.

Comments – Survey Section 1 to 6

Sections 1 through 6 of the survey included questions covering

- the laboratory,
- job titles and salary ranges,
- laboratory customers, and
- acceptance of calibration certificates

Comments provided by individual SLP laboratories are listed in

Lab ID	Comments Survey Sections 1-6
CT	The job description selected for Consumer Protection W&M Inspector has been chosen as Metrology/Calibration Engineer because the inspector that helps in the lab has training in Metrology (Basic Metrology Seminar), have been participating in PTs for the last 7 years and his background is Engineering.
FL	I counted all of the work we did for our inspectors as separate customers. If you want to count our inspectors as one customer then we had 130 total.
IN	We would not accept certificates from L-A-B, LAB, IAS, or Perry Johnson.
KS	There is a significant decrease in the number of customers served for 2020 due to the relocation of the laboratory.
ME	Sorry, cannot determine number of customers that are not W&M officials or service companies.
MN	For section 6: MN accepts calibration certificates from ISO 17025 accredited manufacturers initially, when new weights are purchased.
NC	I do not have an adequate way to determine which companies are NOT W&M officials or Service Companies. I provided a guesstimation.
NE	The Nebraska Statue says we may accept certificates from "a laboratory that is accredited or recognized by NIST". Since NIST does not accredited and because of the relationship between NVLAP and NIST, we may accept certs from a NVLAP lab.
NJ	There were NJ Civil Service Title changed made in 2020. Included in these changes were Weights and Measures Inspector 1 and 3. Prior to 2020, an employee would be promoted from Inspector 3 to Inspector 2 and then to Inspector 1. The order was changed to be consistent with other similar titles of employees of the Division of Consumer Affairs.
NM	The metrology lab is under a different division than the Weights and Measures division, the lab does not see other certificates coming to New Mexico therefore the answer to section 6 is unknown.
SD	SD built a new lab in 2020 located in Sturgis SD. Pierre lab was closed in March 2021.
TN	In section 6 the state law says that it must also be a state lab as well as NIST traceable.
WI	For Section 4: Minimum and Maximum monthly salaries are identified by the working title classification that is assigned to each position within the State system. An employee may exceed the maximum appointment salary after a number of years in state service. Moreover, these values are for new hire(s) with the associated position that is being filled. ; For Section 5: the number of Laboratory Customers reflects nearly three (3) months of telecommuting due to COVID-19. The laboratory was essentially shut down for calibrations during this period. Historically, the lab completes around 400 unique work orders fulfilled during a calendar year.

Table 54.

Lab ID	Comments Survey Sections 1-6
CT	The job description selected for Consumer Protection W&M Inspector has been chosen as Metrology/Calibration Engineer because the inspector that helps in the lab has training in Metrology (Basic Metrology Seminar), have been participating in PTs for the last 7 years and his background is Engineering.
FL	I counted all of the work we did for our inspectors as separate customers. If you want to count our inspectors as one customer then we had 130 total.
IN	We would not accept certificates from L-A-B, LAB, IAS, or Perry Johnson.
KS	There is a significant decrease in the number of customers served for 2020 due to the relocation of the laboratory.
ME	Sorry, cannot determine number of customers that are not W&M officials or service companies.
MN	For section 6: MN accepts calibration certificates from ISO 17025 accredited manufacturers initially, when new weights are purchased.

NC	I do not have an adequate way to determine which companies are NOT W&M officials or Service Companies. I provided a guesstimation.
NE	The Nebraska Statue says we may accept certificates from "a laboratory that is accredited or recognized by NIST". Since NIST does not accredited and because of the relationship between NVLAP and NIST, we may accept certs from a NVLAP lab.
NJ	There were NJ Civil Service Title changed made in 2020. Included in these changes were Weights and Measures Inspector 1 and 3. Prior to 2020, an employee would be promoted from Inspector 3 to Inspector 2 and then to Inspector 1. The order was changed to be consistent with other similar titles of employees of the Division of Consumer Affairs.
NM	The metrology lab is under a different division than the Weights and Measures division, the lab does not see other certificates coming to New Mexico therefore the answer to section 6 is unknown.
SD	SD built a new lab in 2020 located in Sturgis SD. Pierre lab was closed in March 2021.
TN	In section 6 the state law says that it must also be a state lab as well as NIST traceable.
WI	For Section 4: Minimum and Maximum monthly salaries are identified by the working title classification that is assigned to each position within the State system. An employee may exceed the maximum appointment salary after a number of years in state service. Moreover, these values are for new hire(s) with the associated position that is being filled. ; For Section 5: the number of Laboratory Customers reflects nearly three (3) months of telecommuting due to COVID-19. The laboratory was essentially shut down for calibrations during this period. Historically, the lab completes around 400 unique work orders fulfilled during a calendar year.

Table 54: Comments provided by respondents regarding sections 1 through 6 of the survey.

Section 7 Comments

Section 7 of the survey includes questions regarding individual metrologists working in the SLP. Comments provided by individual SLP laboratories are listed in Table 55.

Lab ID	Comments Survey Sections 7
CT	The year eligible for retirement has been calculated when personnel reach the age of 67 which is the year for full (normal) retirement age for the personnel listed in Section 7. Years of Metrology experience of Ion Daha (W&M inspector) has been counting since he attended the Basic Metrology Seminar (in 2008) even he doesn't work full time in the lab (he has been helping the Metrologist in the lab and the last 7 years have been participating in PTs).
IN	Nothing at this time. Working on preasure gauges, or torque calibration sometime in the 2025. After we have the Class 2 , Echelon II certification. Would like to see the NVLAP accreitation as well in 2022.
KS	Metrologist, Evan Johnson has conditional signatory status for legal metrology for Mass Echelon III and Volume Echelon II while NIST training is delayed due to Covid-19.
MD	Grain is not on Scope. State regulator use only.
MI	Santini, Ferguson, Galvan, Byndas are approved signatores for Wheel Load Weighers
MN	Weight carts, Rail test cars and carts (master scale), wheel load scales
NJ	Wheel Load Weighers 20 000 lb to 2 500 lb
NY	We are also recognized for lottery ball weight and lottery ball diameter calibrations.
PA	We are also recognized for force 0 to 50 lbf
USDA-GIPSA	Railroad test cars from 80,000 lb to 110,000 lb. Mass III limited to 25 lb, 50 lb, 1000 lb and 10,000 lb cast iron weights.
VT	Hydrometry: Marc Paquette
WI	Eligibility for retirement is based off of thirty (30) years in state service. With regards, to the lab's Scope, we are currently working on data collection in hopes of becoming Recognized to performed Echelon/Mass II mass calibrations.

Table 55: Comments provided by respondents regarding section 7 of the survey.

Comments – Survey Sections 8 to 31

Sections 8 through 31 of the survey cover the production of measurements by the SLP laboratories and the fees charged for measurement services. Comments provided by individual SLP laboratories are listed in Table 56.

Lab ID	Comments Survey Sections 8-31
AK	Section 31, Alaska doesn't have RSA's.
CT	There is no charge for CT State Agencies and CT City Sealers. Fees are charged to industry's companies. For companies/individuals who uses erquipment for W&M aplications such as dealers and repairmen (registered service companies) there is no charge if the following 3 conditions are met: the company is based in Connecticut or have a place of bussiness in CT, they have a Repairmen or Dealer license from CT, and the technician that use the equipment lives in CT. If one of the conditions is not met the lab will charge for the service. Number of standards/equipment tested in 2020 is smaller than previous years because of the COVID-19 pandemic (lab was closed about 3 months).
KS	• There is a significant decrease in the number of items calibrated for 2020 due to the relocation of the laboratory. • Adjustment fees range anywhere from $5.00 to $50.00 per piece and are the same for in-state and out-of-state customers. • Calibration costs are determined on a per piece basis and range anywhere from $4.00 to $30.00 per piece more for out-of-state customers. • Calibration costs, also, vary on the quantity of items per order for certain items. Ten to ninety-nine items will be cheaper per piece than items in the single digit range and 100 or more items will be cheaper than the ten to ninety-nine quantity. • The Kansas Metrology Laboratory does not have any in-state city, county,or township standards that come to the lab. • The calibration times listed above do not account for everyday laboratory operations (only time per category if a calibration was performed non-stop until complete). • Measurement control time in the above table only refers to obtaining and analyzing data for the immediate measurement being performed. It does not account for extensive analysis.
MA	Director attempting to institute per unit fees rather than per hour. Easier to pre-quote pricing for services to be performed.
MO	We do not charge W&M field equipment and standards for Missouri but we do charge for other states equipment.
NC	Section 26: We test both characteristics - mass & diameter of lottery balls Section 31: Fees are doubled for standards used primarily outside of North Carolina. We do not charge an additional fee to handle standards. There are some set up fees for various calibrations - Gravimetric Calibrations, SLPs and Thermometry
NJ	1. Section 9, Mass Echelon 2: Both Metrologists participated in NEMAP-20-MII-US-01, 6 pc Troemner Metric Weight Kit PT.
NM	We do our own 5 gal slicker plate gravimetrically, I wasn't sure where to put it so I added it to section 17
SC	In Section 9 Echelon II answers, ASTM Class 1 calibrations are included in the numbers.
SD	Shouldn't the weight cart be included in the "Scale Test Truck total"?
USDA-GIPSA	We do maintenance of 5 track scale test cars. Three of the test cars have individual 10,000 lb weights and a 10,000 lb weight cart. Total test weight in two of the cars is 100,000 lb and one car has 110,000 lb. Two of the test cars have a 90,000+ lb self propelled test weight.
VT	All weight calibration is by the hour $75/hour for instate and $95/hour out of state.
WA	Metrology Lab fee is $105.50/hour with minimum fee of one half hour. Fees mandated by the legislature.
WI	NOTE: Weight Cart total includes adjustment. We charge an additional $140.00 for an "adjustment and retest", when applicable. For Section 30, the dollar values are what it would cost a customer for the calibration of those artifacts. We do not charge for unpacking/packing standards nor for the time it takes to input raw data into our Microsoft Access Database, which generates the Certificates of Calibration. However, we may reconsider this item the next time we evaluate our Fee Schedule (~2024 ish). It may take our staff well over an hour to unload a customer and this ought to be factored in at some point. Section 31: in 2018 we stopped charging municipalities for calibration services. While we generate a billing summary of costs, it's strictly for internal record keeping purposes.
WY	Prices listed are in-state customers; out of state charged twice that amount.

Table 56: Comments provided by respondents regarding section 8 through 31 of the survey.

General Survey Comments

At the end of the workload survey the responding laboratory has an opportunity to provide any general comments about the entire survey. These comments are listed in

Lab ID	Comment
AK	Great job!
USDA-GIPSA	You need to do some formatting change to the additional comments sections 8-31.
IN	I would like to thank all the staff that makes this survey happen. One does not know all the hard work that goes on behind the scenes to make this happen for the metrology labs. The Indiana lab has benefitted greatly from the data that is compiled and shared. I cannot speak directly for other lab managers and personnel but I have heard many positive comments over the years now the National Workload Survey has help them in managing their labs and communication with upper management in a more professional way.
MD	Section 7 lists three personnel who perform metrology measurements/functions in the lab, but not all are full-time in the metrology lab. One is 10% time to metrology (mainly PT and administrative work), one is 10% time to metrology (mainly PT, most time focus on NTEP evaluation), one is full time in metrology lab.
MO	Missouri requested some preliminary results because we are trying to increase funding for our Metrology program. These results will assist in demonstrating how Missouri compares to other states not only with what we can calibrate but also the fees charged for various calibrations.
PA	The Pennsylvania Standards Laboratory uses the results of this survey to evaluate fees, staffing and overall workload. The work that goes into getting this information compiled and published is greatly appreciated.
VT	The way we have to input the time and calculate hours isn't particularly relevant to the way our lab develop invoices for mass standards. It would be easier to do everything by the unit, like the way 5 gallon test measures are done.
WI	Suggestion - please consider modifying 'comments' sections to allow various thoughts/comments to be broken up onto separate line items. That is, the comments section appears to be merged & centered into one large field. This prevents me from listing out bullet points, so to speak, and it may be hard to distinguish one comment from another because I cannot apply a new paragraph for separate thoughts. Thank you.

Table 57: General comments provided by respondents of the workload survey.

Section 1

Loaded . . .

Name :	
Phone :	
Fax :	

Section 2

Laboratory Information

Laboratory :	
Address :	
City, State, Zip :	
Web Site :	

Section 3

Laboratory Information

Age of Lab :		yrs
Office Space :		sq ft
Active Lab Space :		sq ft

2020 Workload Survey - Excel Version

The worksheets in this survey are protected to reduce the risk of unintentionally making changes to the survey layout. The survey team uses a group of templates to collect and analyze survey responses in order to expedite the report building process and to reduce the risk of transcription errors when copying your responses from this form. Please do not modify this survey as it will no longer work within the survey team's process if you do. The survey team welcomes your suggestions for improvement. Please add your comments to the comment block at the end of this survey. If you have mockups for an improved layout you may send it in with the completed survey for consideration.

Section 4

List all Job Titles which perform metrology measurements or functions.

Job Title	Minimum Monthly Salary	Maximum Monthly Salary	Select the closest job description from the standardized list below

Section 5

Number of Laboratory Customers served during the reporting period

Count different locations of the same parent company as separate customers. If there are separate divisions with the same parent company, count each as a separate customer.

Laboratory Customers :	
Number of the above that are NOT W&M officials or Service Companies:	

Section 6

Which of the following best describes your State's policy on accepting calibration certificates for field standards from registered service agents/companies in lieu of performing required verification of their testing equipment. Your State will accept calibration certificates from:

(Select 'Yes' for all that apply)	
Your State Lab ONLY :	
Any State Lab regardless of status :	
Any NIST/OWM Recognized Lab :	
Any NVLAP Accredited Lab :	
Any Manufacturer, regardless of accreditation status :	
Any Company or Lab that is Accredited by an Accreditation Body that is an ILAC signatory (e.g. NVLAP, A2LA, ANAB (and L-A-B), LAB, IAS, Perry Johnson)	

Comments: Sections 1-6

Go To Next Sheet (Survey Section 7)

Section 7

1.Please list all current personnel who perform metrology measurements or functions in the laboratory (match with your Scope).

Name	Email	Check Approved Signatory Status (yes or no)									What Year Eligible for Retirement?	#Yrs Metrology Experience		
		Mass I	Mass II	Mass III	Vol Trans	Vol Grav	Length	Time/Frequency	Temperature	Grain Moisture		State Lab Metrology	Other Metrology	Total Metrology Experience

Comments: Sections 7 (include additional items on your scope which are not listed above.)

Go To Next Sheet (Survey Sections 8-31)

Go To Previous Sheet (Survey Sections 1 - 6)

Section 8	**Mass Echelon I** (Match with Handbook 143 and Lab Scope)		
	Number of mass standards calibrated using Advanced Weighing Designs and Mass Code Data Reduction. Regardless of Class. And, ASTM 1 or better, OIML E2 or better.	Lab (Internal)	
		W&M Program[1]	
		External Customers[2]	
		TOTAL	0
Section 9	**Mass Echelon II** (Match with Handbook 143 and Lab Scope)		
	Number of mass standards. ASTM Class 2, 3 OIML Class F1, F2	Lab (Internal)	
		W&M Program[1]	
		External Customers[2]	
		TOTAL	0
Section 10	**Mass Echelon III** (Match with Handbook 143 and Lab Scope)		
	Number of mass standards (except weight carts). ASTM Class 4, 5, 6, 7 OIML Class M1, M2, M3 NIST Class F	Lab (Internal)	
		W&M Program[1]	
		External Customers[2]	
		TOTAL	0
Section 11	**Weight Carts**		
	Number of weight carts calibrated.	Lab (Internal)	
		W&M Program[1]	
		External Customers[2]	
		TOTAL	0
Section 12	**Railroad Test Cars (Master Scale)**		
	Number of cars calibrated.	Lab (Internal)	
		W&M Program[1]	
		External Customers[2]	
		TOTAL	0
Section 13	**Railroad Specific Weight Carts**		
	Number of weight carts calibrated.	Lab (Internal)	
		W&M Program[1]	
		External Customers[2]	
		TOTAL	0

Footnotes: Section 8 - Section 29

1. Count State or Local Jurisdiction owned Weights and Measures Testing Equipment used by State Weights and Measures Program Staff only.

2.External customers includes registered service companies, industry, city/county standards, and standards that do not belong to State officials.

Section 14	**Volume - Glassware**			
	Number of individual pieces of volumetric glassware calibrated. Note: Indicate number of Volume Transfer and/or Gravimetric tests.		Vol-Transfer	Gravimetric
		Lab (Internal)		
		W&M Program[1]		
		External Customers[2]		
		TOTAL	0	0
Section 15	**15.Volume - SVP (Dynamic Volumetric Systems)**			
	Number of small volume provers and closed loop provers calibrated.	Lab (Internal)		
		W&M Program[1]		
		External Customers[2]		
		TOTAL	0	
Section 16	**Volume - LPG**			
	Number of individual LPG provers calibrated.	Lab (Internal)		
		W&M Program[1]		
		External Customers[2]		
		TOTAL	0	
Section 17	**Volume - Non-Pressurized Small Metal Standards (≤5 gallon)**			
	Number of metal volumetric standards (20 liter / 5 gallon and smaller). Note: Indicate number of Volume Transfer (Volume II) and/or Gravimetric (Volume I) tests.		Vol-Transfer	Gravimetric
		Lab (Internal)		
		W&M Program[1]		
		External Customers[2]		
		TOTAL	0	0
Section 18	**Volume - Non-Pressurized Medium Metal Standards (>5 gallon and ≤100 gallon)**			
	Number of metal volumetric standards (larger than 20 liter / 5 gallon and less than or equal to 400 liter / 100 gallon). Note: Indicate number of Volume Transfer (Volume II) and/or Gravimetric (Volume I) tests.		Vol-Transfer	Gravimetric
		Lab (Internal)		
		W&M Program[1]		
		External Customers[2]		
		TOTAL	0	0
Section 19	**Volume - Non-Pressurized Large Metal Standards (>100 gallon)**			
	Number of metal volumetric standards (greater than 400 liter / 100 gallon). Note: Indicate number of Volume Transfer (Volume II) and/or Gravimetric (Volume I) tests.		Vol-Transfer	Gravimetric
		Lab (Internal)		
		W&M Program[1]		
		External Customers[2]		
		TOTAL	0	0
Section 20	**Length - Tapes**			
	Number of individual tapes (metal, fiberglass, woven fiberglass, cloth, etc.). Please enter #devices tested, NOT number of points tested.	Lab (Internal)		
		W&M Program[1]		

Sec		External Customers[2]	
		TOTAL	0
Section 21	**Length - Rigid Rules**		
	Number of individual rigid rules tested. Please enter #devices tested, NOT number of points tested.	Lab (Internal)	
		W&M Program[1]	
		External Customers[2]	
		TOTAL	0
Section 22	**Thermometry**		
	Number of thermometers tested (mechanical, liquid-in-glass, thermocouples, thermistors, PRT, and SPRT).	Lab (Internal)	
		W&M Program[1]	
		External Customers[2]	
		TOTAL	0
Section 23	**Frequency**		
	Number of frequency standards tested (includes tuning forks).	Lab (Internal)	
		W&M Program[1]	
		External Customers[2]	
		TOTAL	0
Section 24	**Timing Devices**		
	Number of timing devices tested (stopwatches).	Lab (Internal)	
		W&M Program[1]	
		External Customers[2]	
		TOTAL	0
Section 25	**Wheel Load Weighers**		
	Number of wheel load weighers tested.	Lab (Internal)	
		W&M Program[1]	
		External Customers[2]	
		TOTAL	0
Section 26	**Lottery Balls**		
	Number of lottery balls tested.	Lab (Internal)	
		W&M Program[1]	
		External Customers[2]	
		TOTAL	0
Section 27	**(A) Other Types of Measurements not covered in this survey**		
	Describe type of measurement:	Lab (Internal)	
		W&M Program[1]	
		External Customers[2]	
		TOTAL	0
Section 28	**(B) Other Types of Measurements not covered in this survey**		
	Describe type of measurement:	Lab (Internal)	
		W&M Program[1]	
		External Customers[2]	
		TOTAL	0
Section 29	**(C) Other Types of Measurements not covered in this survey**		
	Describe type of measurement:	Lab (Internal)	
		W&M Program[1]	
		External Customers[2]	
		TOTAL	0

Section 30 Instructions:

Fee: This is the fee estimate that you would provide a customer in a calibration service quotation.

Average Time: This is the time estimated to complete the calibration work specified in decimal hours.

Includes Unpacking/Packing Standards: Select "Yes" if your time estimate includes receiving equipment for calibration (i.e. unpacking, logging, storing, etc) and prepping equipment for shipment (i.e. palletizing, packing, coordinating pick up, etc)

Includes pre-measurement setup time: Select "Yes" if your time estimate includes time setting up the measurement area (i.e. setting up measurement standards, instrument warm up time, staging customer equipment, etc.)

Includes measurement control related work: Select "Yes" if your time estimate includes time spent obtaining and analyzing measurement control data.

Includes certificate preparation time: Select "Yes" if your time estimate includes time spent preparing and error checking the calibration certificate.

Section 30	In this section please estimate the typical fees charged for each of the described examples and enter the average time required for each item.		Fee	Average Time (enter time in decimal hours)	Includes Unpacking/Packing Standards	Includes pre measurement setup time	Includes measurement control related work	Includes certificate preparation time
	If you have a minimum fee for a test, what is it?							
	[Mass Echelon I] ASTM Class 0 Precision mass set - 100 g to 1 mg (21 weights) :							
	[Mass Echelon II] ASTM Class 2 Precision mass set - 100 g to 1 mg (21 weights) :							
	[Mass Echelon III] One - 31 lb Class F weight kit (22 weights) :							
	[Mass Echelon III] 5,000 lb weight cart :							
	Mass Echelon III Large Scale Test Truck	24 - 1000 lb weights (5 adjusted) :						
		20 - 50 lb weights (5 adjusted) :						
		2 - 31 lb weight kits (22 weights each) :						
		Scale Test Truck Total :	$ -	0.0				
	One - 5 gallon test measure using volume transfer method :							
	One - 5 gallon test measure using gravimetric method :							

One - 100 gallon prover using volume transfer method :							
One - 100 gallon prover using gravimetric method :							
One - 100 gallon LPG prover :							
One - 100 foot tape with 19 points tested :							

Section 31	Do you charge:	
	Do you charge out of state customers higher fees than in state customers?	
	Do you charge for calibrating W&M field equipment and standards?	
	Do you charge for calibrating city, county, township (political jurisdiction W&M) equipment and standards?	
	Do you charge for calibrating registered service company equipment and standards?	

Comments: Sections 8-31

Go To Supplimentary Questions 1.

Go To Previous Sheet (Survey Section 7)

Section 32: *Supplementary Questions 1. (Yes/No)*		
1	Did your workload increase in 2020 because of COVID?	
2	Did your workload decrease in 2020 because of COVID?	
3	Did you have mandatory furlough time in 2020 because of COVID?	
4	Did you experience other budget cuts?	
5	Did you defer the purchase of new lab equipment in 2020 because of COVID?	
6	Were you required to hold a vacant metrology position open because of budget cuts due to COVID?	
7	Did COVID delay having your lab standards calibrated or accredited?	
8	Did COVID delay staff training (NIST provided or internal)?	
9		
10		
11		
12		
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17		
18		
19		
20		

Comments, Supplementary Questions 1.

Go To Supplementary Questions 2.

Go To Previous (Sections 8 - 31)

Section 33: *Supplementary Questions 2. Short Answer*		
1	In #1 - #10 identifiy some requests for calibration services that you are currently unable to provide.	(Give a brief description)
2	#1	
3	#2	
4	#3	
5	#4	
6	#5	
7	#6	
8	#7	
9	#8	
10	#9	
11	#10	
12	Which version of Excel are you using?	
13	Briefly describe any safety protocols your laboratory implemented in order to cope with COVID-19 (i.e. mandatory masks, limited face to face interactions, sanitation requirements)?	
14		
15		
16		
17		
18		
19		
20		

Go To Survey Comments

Back To Supplementary Questions 1.

Section 34	Comments on Survey

Go To Prevous Sheet (Supplementary Questions 2.)

End of Survey